EXPANDED ENGINEERING EVALUATION/ COST ANALYSIS FOR THE BALD BUTTE MILLSITE AND DEVON/STERLING AND ALBION MINE SITES

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1.0 INTRODUCTION

The Bald Butte Millsite and Devon/Sterling and Albion Mines project is located approximately 17 miles northwest of Helena, Montana near the headwaters area of Dog Creek. The headwaters of the basin are located on the west side of the Continental Divide southwest of the historic mining community of Marysville and the project encompasses the western portion of the Marysville Mining District. This document presents the Expanded Engineering Evaluation and associated Cost Analysis (EE/CA) for the reclamation of the abandoned tailings and waste rock piles included in the Bald Butte Millsite and Devon/Sterling and Albion Mine sites. The data used for this evaluation was presented in the site characterization report for the Bald Butte Millsite and Devon/Sterling and Albion Mine sites (DEQ-MWCB/Olympus, 2004) prepared by Olympus Technical Services, Inc. (Olympus) and submitted to the DEQ-MWCB in March 2004. The project area includes the Bald Butte Millsite tailings and waste rock areas and the Devon/Sterling and Albion Mines waste rock area (Figure 1-1). The Bald Butte Millsite tailings and waste rock are currently ranked No. 11 on the Montana Department of Environmental Quality, Mine Waste Cleanup Bureau (DEQ-MWCB) Priority Sites List. The Devon/Sterling and Albion Mines are not ranked on this list.

The Bald Butte Millsite and the Devon/Sterling and Albion Mines are located approximately 3.8 and 3.0 air miles, respectively, southwest of the town of Marysville in Lewis and Clark County, Montana within the E ½ of Section 9, NW ¼ of Section 10, E ½ of Section 16 and NE ¼ of Section 21, Township 11 North and Range 6 West, Montana Principal Meridian (Figure 1-1). Figure 1-2 is an aerial orthophotograph taken in 1995 that shows an overview of the site areas. The sites are located within the Dog Creek drainage, a tributary of the Little Blackfoot River. There are several possible access routes to the site. The most accessible route is to proceed west on Highway 12 from Helena over MacDonald Pass. Near the bottom of MacDonald Pass, turn right on Dog Creek Road, which becomes Forest Road 1855, and follow it for approximately 12.8 and 13.5 miles to the millsite and mines, respectively.

Field Sampling, Laboratory Analytical and Quality Assurance Project Plans for were prepared for the site in September 2003 (DEQ-MWCB/Olympus, 2003a, 2003b, 2003d and 2003e). These documents outline the sampling and analytical methods used to generate the site characterization database. The site characterization work was performed during the fall of 2003. The Site Characterization Report DEQ-MWCB/Olympus, 2004) presents the data with the following evaluations:

- Background Soil Quality;
- Mine/Mill Waste Characteristics;
- Sediment Characterization;
- Surface Water and Groundwater Characteristics;
- Assessment of Airborne Particulate Emissions;
- Assessment of Physical Hazards;
- Summary of Contaminant Exposure Pathways, and
- Potential Borrow Source and Repository Site Investigations.

1.1 REPORT ORGANIZATION

The Expanded EE/CA report is organized into 11 sections. The contents of each section are briefly described below and on the following pages:

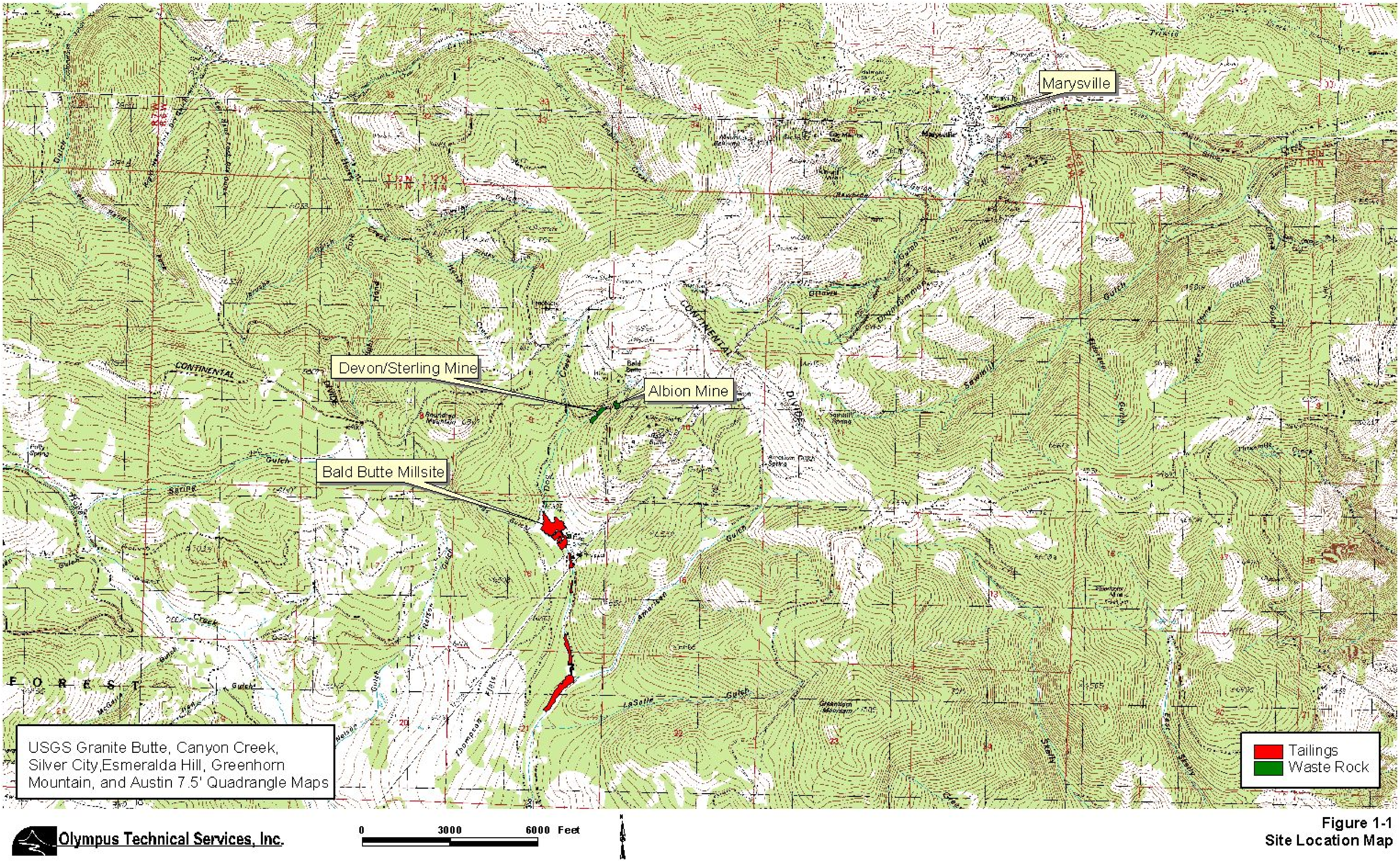

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Figure 1-1
Site Location Map

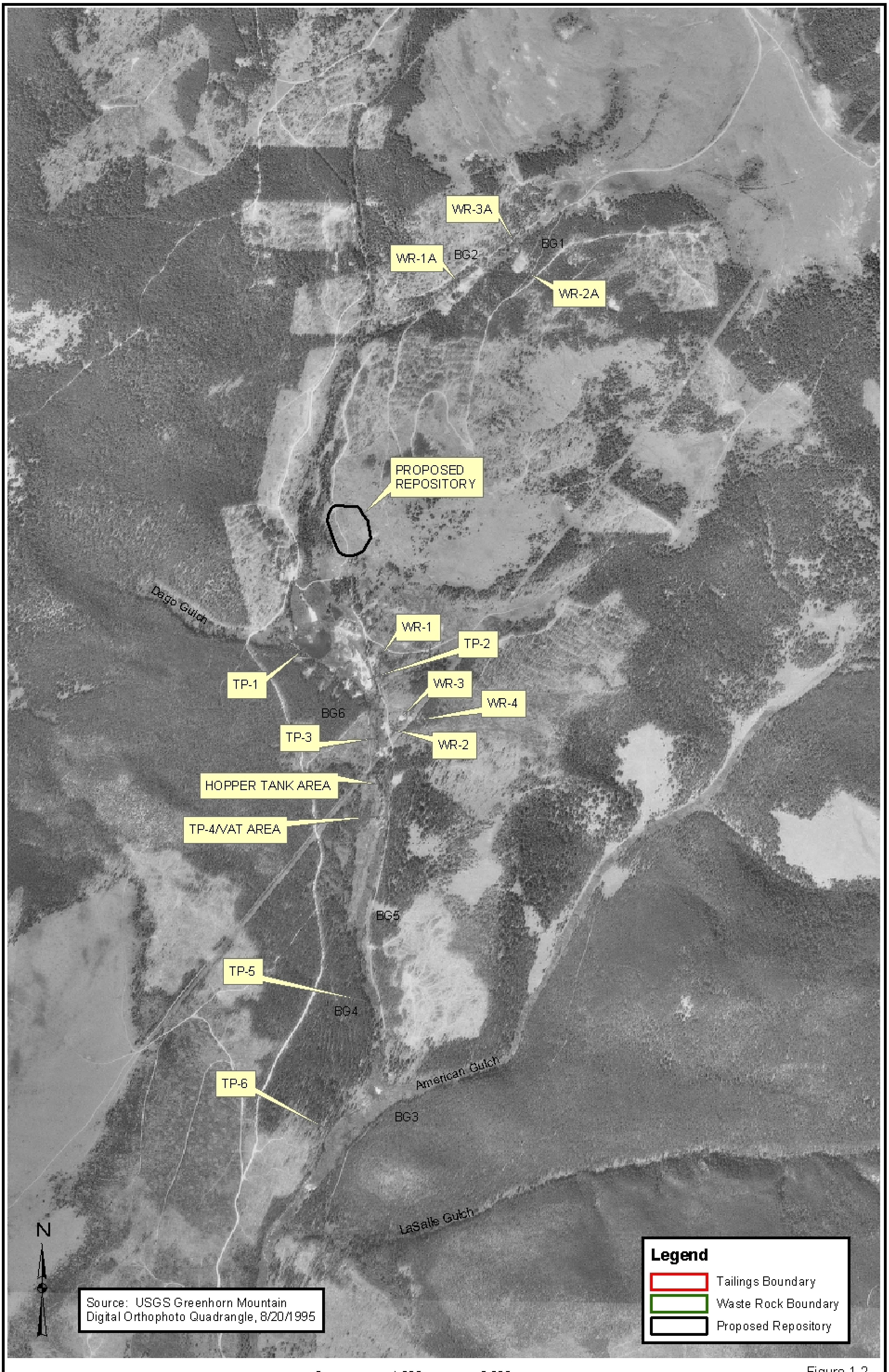

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Figure 1-2
Aerial Photograph of the Bald Butte Millsite
and Devon/Sterling and Albion Mines

SECTION 2.0 BACKGROUND - presents a background description of the Bald Butte Millsite and Devon/Sterling and Albion Mines project's significant site features including: a detailed history of past mining and milling activities; geologic, hydrologic, and climatic characteristics of the site; the biological setting, such as the wildlife and fisheries resources and the vegetation indigenous to the area; threatened and endangered species concerns; and the cultural setting issues, such as present and future land uses, are described in this section.

SECTION 3.0 WASTE CHARACTERISTICS AND SUMMARY OF THE SITE CHARACTERIZATION - presents the results of the Site Characterization Report which describes the characteristics of the wastes present at the site, including types, volumes, and contaminant concentrations. The impact to groundwater, surface water and stream sediments, an assessment of airborne particulate emissions and the results of the potential repository site investigations are also described in this section.

SECTION 4.0 SUMMARY OF THE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS - presents the Montana Federal and State government requirements which are considered applicable or relevant and appropriate (ARAR) for the reclamation effort. Requirements discussed in this section are chemical-, location-, and action-specific ARARs.

SECTION 5.0 SUMMARY OF RISK ASSESSMENT - presents the risk analysis performed for the site. Potential sources, routes of exposure, and potential receptors are evaluated to determine the relative threats posed by each potential source within the project boundary. This evaluation is incorporated into a baseline Human Health Risk Assessment and an Ecological Risk Assessment.

SECTION 6.0 PRELIMINARY RECLAMATION GOALS - presents the reclamation objectives and applicable clean-up standards. Where appropriate, these objectives specify contaminants of concern (CoCs), media affected, exposure pathways, and preliminary reclamation goals (PRGs) for each environmental medium. PRGs are numerical values based on identified chemical-specific ARARs. PRGs are developed based on both ARARs and the results of the Risk Assessment activities.

SECTION 7.0 DEVELOPMENT AND SCREENING OF RECLAMATION ALTERNATIVES - identifies and screens potentially applicable reclamation alternatives. Reclamation alternatives are evaluated based on effectiveness, implementability, and cost.

SECTION 8.0 DETAILED ANALYSIS OF RECLAMATION ALTERNATIVES - presents a detailed analysis and comparison of the final screened alternatives against the National Contingency Plan (NCP) evaluation criteria. This includes a qualitative evaluation of threshold criteria, and how each alternative will mitigate risk from the contamination and comply with ARARs.

SECTION 9.0 COMPARATIVE ANALYSIS OF RECLAMATION ALTERNATIVES - compares the reclamation alternatives for consistency with ARAR requirements and develops the design approach for the final reclamation of the site.

SECTION 10.0 PREFERRED ALTERNATIVE - proposes a preferred reclamation alternative for the final reclamation activities at the site.

SECTION 11.0 REFERENCES - lists the references cited in the text.

2.0 BACKGROUND

Background information for the Bald Butte Millsite and Devon/Sterling and Albion Mines are summarized in the following sections:

- Mining History
- Climate
- Geology, Hydrogeology, and Hydrology
- Current Site Setting

2.1 MINING HISTORY

A good summary of the Bald Butte Mill operating history was compiled in the site cultural resource inventory and assessment (DEQ-MWCB/Frontier Historical Consultants, 2003). The following summary of the site operational history draws from this document and other sources. The Devon/Sterling and Albion Mines were two of the mines that provided ore to the Bald Butte Mill. The Bald Butte mine most likely comprises the Devon/Sterling and Albion mines along with other mine operations located around Bald Butte.

The Bald Butte mine is located in the NW ¼ of Section 10, Township 11 North and Range 6 West on the northwest slope of Bald Butte near the head of Dog Creek. The operation was run by the Bald Butte Mining Company which later changed its name to the Bald Butte Mining and Milling Company in 1911. The mine was first discovered on the Albion vein. Later, the “Main Branch” was discovered at the site of the Sincox shaft and this orebody was developed by Tunnels 1, 2, 4, and 6 with intermediate levels. The lower zone of profitable ore was between the No. 6 tunnel and the 800 foot level of the Sincox shaft. Other veins in the mine that were worked profitably include the New Branch, Knife Blade, Elixer, Lone Jack and Cross Course (Montana Bureau of Mines and Geology n.d. and Ropes, 1901). According to Walker (1992), the underground mine was developed for 500 vertical feet to approximately the 6,300 feet elevation beneath Bald Butte.

The first reported production from the mine occurred in 1882 when the mine produced $32,000. Bald Butte Mining Company annual reports for 1895 and 1896 (Tatem, 1895 and 1896) provide some valuable insight into the early mining and milling history of the property. The ore was treated in the company’s 10-stamp mill that was expanded to 40 stamps in late 1891. The mill is located approximately 0.9 mile southwest from the top of Bald Butte. During 1894 and 1895, the mine produced 20,175 and 20,413 tons of ore, respectively. In addition to the ore extracted in 1895, an additional 15,000 tons of ore were broken in the mine during the year for extraction in 1896. In 1894 and 1895, the 40-stamp mill operated 24 hours per day for 315 1/3 days (64 tons/day) and 325 days (63 tons/day), respectively. Underground mine development in 1894 and 1895 was 826 feet and 860 ½ feet, respectively. This work was conducted in the No. 1 and No. 2 Tunnels. The No. 2 Tunnel was being advanced to intersect the downward extension of the main vein that was being mined in the No. 1 Tunnel. Although the No. 2 Tunnel intersected the vein in 1895, not much progress was made on ore extraction due to significant volumes of water encountered. It was noted in the 1895 annual report that the mill experienced periodic shutdown due to the lack of water. A capital expenditure was made to develop a large natural spring situated near the head of the Cold Spring Placer claim to provide an additional source of water for the mill. Water was piped 2,000 feet via a 4-inch diameter line from the spring to the mill. In the 1896 annual report, it was noted that capital expenditures were made to enable the company to better restrain its tailings and avoid damage suits. These expenditures included the acquisition of 40 acres of placer ground on Dog Creek and the enlargement and strengthening of the tailings dam.

The Montana DEQ (DEQ-MWCB, 2003) summarized some of the Bald Butte mine production history as follows. The Bald Butte property was worked from 1890 to 1901 when a new vein was discovered. In 1902, the mine produced 25,565 short tons of ore which was processed and produced 14,776.24 ounces of gold; 8,939 ounces of silver; 4,588 pounds of copper; and 81,962 pounds of lead. After 1902, the ore produced from the mine dwindled until 1909 when only 814 tons of ore were extracted. Production was resumed in 1912 with 3,230 tons of ore producing $,408.25 (sic) in gold and lesser values of silver, copper and lead. Until 1923, the production fluctuated widely from 5 tons in 1916 to 9,900 tons in 1920. After 1915, the greatest production was from reworking old tailings. The 18 claim property reopened in 1931 by Idamon Gold Mining Co. and operated soon thereafter by Bald Butte Gold Mines, Co. and Stratton and Stratton of Wallace, Idaho. In 1932, the main adit was reopened and a new tunnel was driven from the north side of the mountain. Again most production occurred in years in which old tailings were reworked.

It was reported in the Mining Review of the Greater Helena Region 1934-1935 (July, 1935) that the mine belonged to the Stratton interests of Wallace, Idaho, under whose direction the mining was being resumed in the so-called Elge tunnel. This report also indicated that a new compressor house was installed and the machinery removed from the former tunnel mouth in 1934.

Total production from 1902 to 1942 has been calculated at 167,595 tons of ore which returned 55,390.90 ounces of gold; 49,020 ounces of silver; 34,814 pounds of copper and 209,509 pounds of lead and the estimated total value of gold and silver production from the Bald Butte mine is $3,500,000 (Knopf, 1913; Sabin, 1933; Gilbert, 1935; McClernan, 1983 and Walker, 1992). The principal production came from eight veins in the Genesee claim plus the Albion vein.

Contemporary reporters mentioned the possibility of re-treatment of Bald Butte mill tailings in 1906, but the first such work probably dates to 1909-1910 (Mining World, 1906; Mineral Resources, 1909; MBMG, 1907-1931). During this period, the interest in old tailings reflects a general trend in the district and throughout western Montana. The Bald Butte company leased the tailings to unnamed lessees, who worked the material during 1909 and probably during 1910 as well (Ibid.; Mineral Resources, 1910).

When mine production and mill operations were minimal during this period, a lessee instituted a significant program of reprocessing mill tailings by cyanidation (Mineral Resources, 1915). Beginning in late 1915, the Tower and Templeman Leasing Company, a Butte partnership, held the lease on the tailings. Serious re-treatment began in the fall of 1916 and continued through 1922, if perhaps intermittently (Mining and Engineering World, 1916; Mineral Resources, 1918; 1920; 1921; 1922; MBMG, 1907-1931). The Tower and Templeman operation was a 200-ton cyanide plant. Tailings were sluiced to the plant and classified, the sands were leached, and the slimes were agitated, settled, and filtered (Mineral Resources, 1916). The plant's location is unspecified in the sources consulted, but was likely near the lower end of the 40-stamp mill's tailings pond. Olympus observed the remnants of the vat leach tank operation approximately 1,100 feet downstream from the tailings pile TP-2 dam. Tower and Templeman leased tailings on the Larson Group beginning in 1919, while also working old tailings from the Bald Butte property for the next three years (Lewis and Clark County; MBMG, 1907-1931).

In the early 1900's, while Bald Butte Gold worked at mine development, others reworked the mill tailings. In mid 1933, E.J. Colwell, R.P. Colwell and D.D. Billet signed a five-year agreement with Kate Larson allowing them to process tailings located on the Larson Group of claims. About six months later, they assigned 50 percent of their interest in the agreement to Julius A. Peters and Wade V. Lewis. In return, Peters was to build a mill to treat tailings. By some unknown agreement or partnership between the Colwell party and the Atlas Mines Corporation, Atlas Minerals erected a 500-ton flotation mill on the Larson Group in the summer of 1934. The company used a force of 40 men who processed 4,200 tons of tailings in 1934, and perhaps 1,000 tons in 1935 (Minerals Yearbook, 1935; McClernan, 1983; Mining Journal, 1934; MBMG, 1935). The Colwell party and Atlas Mines apparently abandoned the site in late 1935 or early 1936 because by mid-1936 the flotation plant had been removed. An unnamed lessee was said to have had a power shovel on-site at that time (Mining Journal, 1936).

In the fall of 1937, J.C. Archibald signed a purchase option to the tailings rights. By 1938, tailings were being treated in his 100-ton cyanide plant and the plant presumably stood on the Larson Group where Atlas Mines' flotation mill had been a few years previous (Minerals Yearbook, 1939; 1940). Archibald continued tailings reprocessing operations through 1941 (Minerals Yearbook, 1939; 1940; 1941). The company processed a total of 41,827 tons of tailings (McClernan, 1983).

Molybdenum exploration was conducted in the mid-1960s in the Bald Butte area. Work was done by AMAX Exploration, Inc. Drilling in the area of Empire Creek during the early 1970s disclosed anomalously high heat flows. This work spawned an intense heat flow study program which cumulated in the drilling of a 6,809 feet deep geothermal hole by the U.S. Government under the direction of Battelle Laboratory with geological guidance from Southern Methodist University. The work indicated that both the molybdenum and geothermal prospects were not economically viable (Walker, 1992 and Blackwell and Morgan, 1975).

The Albion was owned by Helena businessmen and mine investors Benjamin H. Tatem, William Chumasero, Walter F. Chadwick and David H. Gilmour. The Albion was promising enough that there was talk in the spring of 1880 of building a mill to treat the ore. By late 1881, a single-stamp mill was crushing Albion ore. It's location is uncertain, but it may have stood on Dog Creek where the owners had earlier planned for its location (Ibid.; Engineering and Mining Journal 32, no. 1 & 26, 1880; U.S. Director of the Mint, 1882). Mining operations at the Albion mine continued at a good pace during the following two years, and mine owners were optimistic enough to construct a larger stamp mill. In the fall of 1883, they erected a 10-stamp mill, again at an uncertain location (U.S. Director of the Mint, 1883; 1885). The first reported production from the mine occurred in 1881 when the mine produced $32,000 (MBMG 1907-1931). Not long after the 1883 mill was built, the Albion went unreported and presumably was not worked for the next five or six years. Owners Tatem and Chumasero, plus two other men, formed the Bald Butte Mining Company in 1890 in order to resurrect the old Albion Mine (Montana Secretary of State, 1890). The company reopened the mine that June, employing 20 miners who worked via an inclined shaft (Montana Inspector of Mines, 1891). For the first half of the new mine's operation, the company ran ore through the old 10-stamp mill, but by late 1891, a 20-stamp mill was in place (Tatem, 1901). Three years later, the company erected a 40-stamp mill which, today is referred to the Bald Butte Mill.

2.2 CLIMATE

There are no official weather stations in the Dog Creek drainage. There are three weather stations within an 8- to 11-mile radius around the Dog Creek drainage. National Oceanic and Atmospheric Administration's Western Regional Climate Center has compiled temperature and precipitation data at Canyon Creek (241450), Austin (240375) and Elliston (242738), Montana for the periods May 6, 1907 through March 31, 1979, April 12, 1950 through December 31, 2001 and April 25, 1951 through May 31, 1977, respectively. These appear to be the closest official weather stations to the Dog Creek drainage. Canyon Creek and Austin are approximately 8 miles northeast and 8 miles southwest of the site, respectively. Elliston is approximately 11 miles south-southwest of the site. The average annual maximum and minimum temperatures recorded at the Austin site were 53.6 degrees Fahrenheit (°F) and 29.6°F, respectively. The average annual maximum and minimum temperatures recorded at the Elliston site were 53.3°F and 25.8°F, respectively. Temperature data were not reported for the Canyon Creek site. The average annual total precipitation for the Canyon Creek, Austin and Elliston sites is 10.82, 16.15 and 15.45 inches, respectively. The lowest and highest average precipitation occurs in the months of February/March and May/June, respectively. Average annual total snowfall is 43.2, 59.9 and 87.9 inches for Canyon Creek, Austin and Elliston, respectively. Most snow falls from December through April.

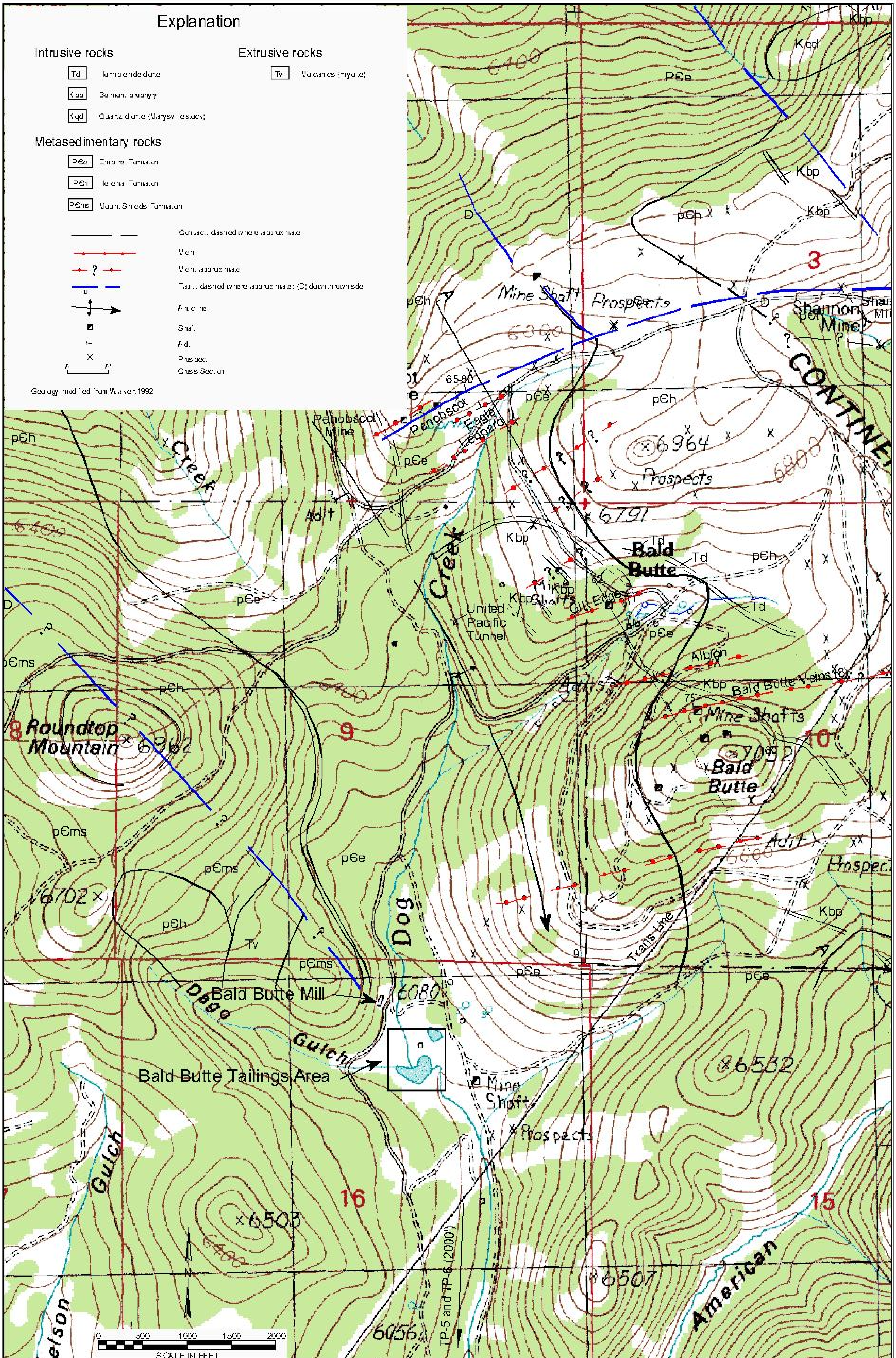
Like most of southwestern Montana, the Dog Creek drainage is subject to a cool and dry continental-dominated climate. The temperature of the region is marked by wide seasonal and daily variations. During winter, the temperature can fall lower than 30 degrees below zero Fahrenheit. During summer, many days reach the 80's and 90's but due to the generally arid climate and lightness of the mountain air, the temperature can drop substantially at nightfall. Approximately half of the annual precipitation falls as snow during winter (90 inches average annual snowfall). Stormy weather usually brings the first snow during September, however, these "equinoctial storms" are generally succeeded by several weeks of fair weather. By November, the area is usually blanketed with snow. Heavy snows are frequent in the winter as are periods of melting and freezing which occur as a result of warm Chinook winds that occasionally blow from the west. The snowpack generally remains in the area for six months or longer, with spring thaw occurring in April or May (NOAA, 1988).

The area is subject to a distinct spring/summer rainy season with May or June usually being the wettest month of the year. On average, May and June each receive 3.5 inches of precipitation. The frost-free period (32° F or more) averages approximately 70 days annually, from mid-June to late August (NOAA, 1988).

2.3 GEOLOGY, HYDROGEOLOGY, AND HYDROLOGY

2.3.1 Local and Regional Geology

The geology in the greater Marysville, Montana area consists of Precambrian metasedimentary rocks intruded by late Cretaceous to Tertiary igneous rocks ranging from the quartz diorite Marysville stock to the quartz porphyry at depth in the Bald Butte area (Figure 2-1). Lesser igneous intrusions consist of dikes of variable composition. The northwest-southeast Cretaceous Belmont porphyry dikes are some of the more common and are composed of crystals of andesine feldspar, with prisms of hornblende and lesser flakes of biotite, in a dark



Olympus Technical Services, Inc.	DEQ-MWCB Bald Butte Millsite Lewis & Clark Co., Montana	GEOLOGIC MAP FOR THE BALD BUTTE MILLSITE AND DEVON/STERLING AND ALBION MINE AREAS	FIGURE 2-1

DESIGN: CRS	DRAWN: CRS	CHECKED: KSR	APPROVED:	DATE: 5/13/02	JOB NO: A1371	SCALE: As Shown	FILENAME: A1371Geo Map.dwg

gray groundmass. Knopf, (1913) believed these dikes were injected shortly after the intrusion of the main quartz diorite Marysville stock. Precambrian Belt Series Empire Formation (mudstone, metamorphosed to slate/hornfels) is composed of compact, locally calcareous, light to dark, greenish-gray shale. Near the Marysville stock, the shale has been metamorphosed to fine-grained, light to dark green, gray or black hornfels that is banded green or purple and includes rare, dark-colored cordierite-bearing horizons (Walker, 1992 and Blackwell, 1974). The Precambrian Belt Series Helena Formation (limestone and dolomite) consists of two lithologies, commonly interbedded on the outcrop scale. Most common is impure siliceous limestone which occurs as edgewise conglomerate or "molar tooth" structure (Knopf, 1950). The gray limestone weathers readily while the buff, quartz-calcite-mica matrix stands out on the weathered surface. The second lithology is white, siliceous dolomite that weathers brown (Walker, 1992 and Blackwell, 1974). Between the Empire and Helena formations is a transitional zone about 132 feet thick. The contact is drawn near the middle of this zone where calcite-rich rocks become common. The transitional rocks are most commonly banded hornfels containing white and light to dark green bands one half to one centimeter in width. At low grades these rocks locally have the appearance of shale, but their metamorphic character is shown by the presence of talc.

A complex series of rhyolite quartz porphyry intrusions capped by a zone of silica flooding was discovered beneath (< 300 feet) Bald Butte during the course of molybdenum exploration by AMAX Exploration, Inc. The main Bald Butte quartz porphyry, dated at 49 million years ago (Ma), was later intruded by a series of quartz porphyry dikes and sills ranging from 37 to 40 Ma (Walker, 1992 and Blackwell and Morgan, 1975). With slight variations, these rocks are characterized by quartz phenocrysts in a light-colored, fine-grained to aphanitic groundmass.

Tertiary rhyolites occur in limited exposures south of Bald Butte. The rhyolite includes angular, smoky quartz phenocrysts in a light-gray, aphanitic groundmass. The rock has been dated at 37 Ma (Walker, 1992 as per written communication from Marvin Ratcliff, 1972).

The major features of the Marysville area structural geology are three stages of faulting and a doubly plunging anticline (Walker, 1992). An early fault stage is represented by a northwest-striking pattern developed concurrent with folding. This system is characterized by relatively wide-spaced fractures dipping 65-90 degrees southwest. They occur primarily along the axis of the anticline, or in metasediments between it and the Marysville stock. Their position is marked by later Belmont dike intrusions.

A middle stage of faulting followed the intrusion of the Belmont and Drumlummon porphyry dikes. This stage is the most important to vein mineralization and the faulting produced three distinct patterns. The district scale pattern is somewhat radial with strikes ranging from near east-west in the southern part of the district to northwest in the northern part. The pattern tends to focus on the southeastern contact of the Marysville stock, possibly due to the change in rock types. These faults are commonly normal and primarily dip slip with persistent strike lengths of 12,000 to 15,000 feet and attitudes that are generally steeply south to vertical. Two lesser dominant patterns are not persistent with strikes N60°-70°W and N40°-60°W and dips of 60°-80°SW and 40°-60°NE, respectively. Late stage faulting occurred after mineralization. These faults strike N25°-40°W, are near vertical in dip and control the Empire Creek graben and several other smaller down-dropped blocks. Veins associated with the Empire, Mount Pleasant and Blue Bird-Hickey-Shannon mine areas are offset by these late-stage faults.

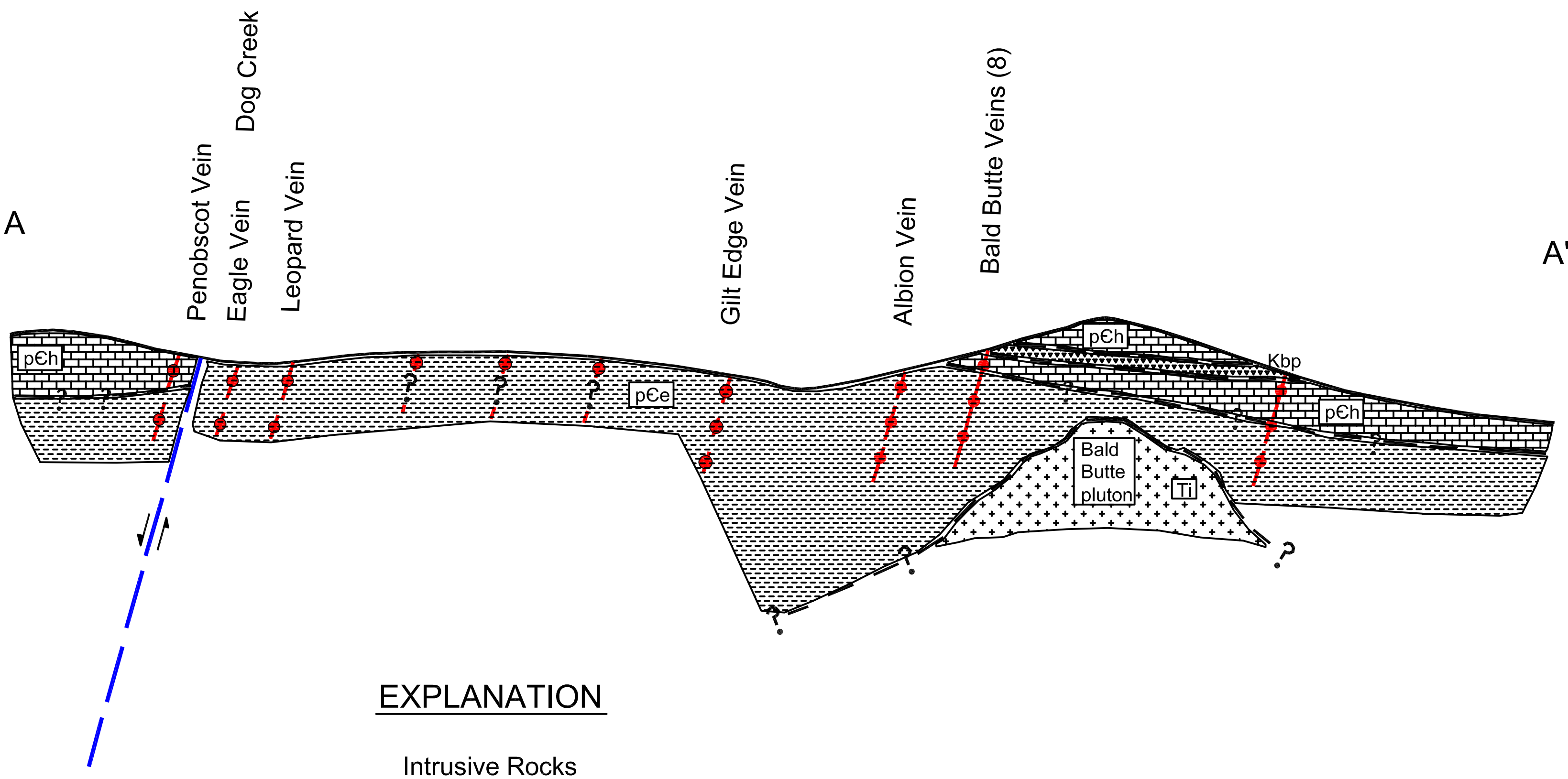
The Bald Butte - Empire Creek Anticline is the principal fold structure in the Marysville district. This fold is a doubly plunging anticline that extends from Empire Creek southeast to Bald Butte. Its origin possibly reflects a combination of doming from the underlying Tertiary intrusions coupled with compressional tectonism of the Empire and Helena Formations. The general area of the anticline also corresponds with a crustal heat anomaly.

The main precious metal mineralization in the greater Marysville Mining District is present in a northeast - southwest fissure vein system. The veins formed during the middle stage of faulting and are associated with east-west to northwest-striking radial faults (Walker, 1992). Splits are common along the major fissures and can range from insignificant structures that rapidly pinch off, to significant ore-bearing veins. Economic vein widths range from 2-4 inches (Knife Blade vein at Bald Butte) to 45 feet in the 9-hour stope at the Drumlummon mine. Based on available mine information, the average vein width was probably 3 to 10 feet. At the Bald Butte mine, the intersection of veins with Belmont porphyry dikes was significant in that the veins were split into several strands, each of which was mined. Historical mining has shown that the bottoming of ore shoots is generally marked by a diminution in precious metal values.

Hydrothermal alteration associated with the mineralization event is predominantly manifested as bleaching and kaolinization (Walker, 1992). The Bald Butte area is somewhat unique in the district for there is an intense silicification cap associated with the underlying Tertiary intrusions. Progressing outward from the silica flooding, the metasediment host rocks exhibit intense biotite and orthoclase alteration.

The local geologic setting for the Bald Butte Millsite is presented on Figure 2-1 and in the cross section depicted on Figure 2-2. Minerals exploration drill holes intersected the concealed Bald Butte pluton at depth beneath Bald Butte (Walker, 1992). This quartz-feldspar porphyry has intruded into the Empire Formation along the eastern limb of the Bald Butte-Empire anticline and produced intense silicification in the metasedimentary rocks. Progressing outward from the silicification zone is development of intense potassic alteration that is manifested by the presence of biotite and orthoclase in the metasedimentary rocks. The contact between the Empire and Helena Formations occurs immediately to the west of Bald Butte, as does the axis of the Bald Butte-Empire anticline. Precious metal vein mineralization in the Bald Butte area is unique with respect to the Marysville Mining District in that fluorite and molybdenum are commonly associated accessory minerals along with the typical quartz, calcite and adularia gangue. The fluorite and molybdenum mineral phases are most likely related to the quartz-feldspar porphyry intrusion, as is the intense silicification and potassic alteration. The quartz-feldspar porphyry igneous rocks, mineralization and alteration, along with the zone of high crustal heat flow in this area, are characteristic of known molybdenum deposits that are currently being mined elsewhere in the U.S.

The mineralized vein system in the Bald Butte area is a series of en-echelon, northeast-striking, veins. The principal veins mined from underground workings in the Bald Butte area were the eight Bald Butte veins and the Albion vein. The veins are commonly associated with fault structures which occur in the metasedimentary rocks and the Belmont porphyry dikes. Gold and silver occur along with some pyrite, chalcopyrite, galena, and sphalerite. The sulfide minerals generally increase with depth in the district and this factor caused some precious metal mining operations to become uneconomic and to cease operations. However, in the Bald Butte area, more recent exploration conducted in the 1980’s revealed that gold mineralization persists with depth below the 6,100 feet elevation of the bottom of the mine workings. Drilling has intersected 3 to 4 feet of greater than 1 ounce per ton (oz./ton) gold to at least the 5,700-foot elevation (Walker, 1992).

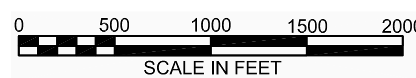


EXPLANATION

Intrusive Rocks

Tertiary — Ti — Quartz/Quartz-feldspar porphyry pluton

Cretaceous — Kbp — Intermediate porphyries (Belmont porphyry)



Metasedimentary Rocks

Precambrian — pЄh — Helena Formation

pЄe — Empire Formation

Modified from Walker, 1992

Olympus Technical Services, Inc.	Scale: As Shown Job No: A1347 File: A1347GeolMap.dwg	Geology Cross Section A - A'	FIGURE 2-2

2.3.2 Hydrogeology

Based on a review of standard hydrogeologic literature sources, no published hydrogeologic information specific to this area has been prepared. The interpretation of hydrogeologic conditions presented here is based on accepted hydrogeologic principals, local observations and available geologic information. The Bald Butte Millsite waste sources are located within the drainage basin of Dog Creek, a tributary to the Little Blackfoot River.

The hydrogeologic system contains two main components; bedrock and alluvial valley fill. The bedrock is moderately fractured and contains vein structures associated with the intrusion of the stock. Numerous fractures are present in the bedrock, including bedding structures, joints and faults associated with the tectonic history, and vein structures. Due to the complex and unpredictable nature of the bedrock structures, it is likely that the rate and direction of groundwater flow is widely variable over short distances. Permeability and transmissivity of the bedrock aquifer system probably vary widely. The alluvial deposits are thin, shallow, and discontinuous and likely transmit both surface water from local streams and discharging bedrock groundwater.

Groundwater flow likely follows local stream gradients and topography, with groundwater discharging to gaining alluvial streams which is typical of high mountain drainage systems. However, local bedrock fault systems and secondary solution features probably exert significant control on the direction and rate of groundwater flow, as do the underground workings associated with the mines in the area.

2.3.3 Surface Water Hydrology

The Bald Butte Millsite occurs within the Dog Creek drainage, which includes Dago Gulch and an unnamed tributary south of Bald Butte. The site is located near the headwaters of Dog Creek and the tailings ponds are approximately two miles from the continental divide. Tailings piles TP-1 through TP-6 are located in the active Dog Creek stream drainage. Waste rock piles WR-1 through WR-4 are located above the Dog Creek floodplain. The Devon/Sterling and Albion mine sites are located near the headwaters of Dog Creek within the unnamed tributary on the north side of Bald Butte. The waste rock piles associated with these two mines are located within and adjacent to the unnamed, perennial stream tributary of Dog Creek.

The peak discharges for Dog Creek in the vicinity of the Bald Butte Millsite were estimated using regional flood-frequency equations developed by the USGS (Omang, 1992) and are presented in Table 2-1. The flood-frequency equations for the southwest region of Montana are based on the drainage area (4.994 square miles) and the percentage of the basin area that is above 6,000 feet in elevation (96.1 percent). The drainage area for the Bald Butte Millsite is shown on Figure 2-3.

The peak discharges for the unnamed tributary in the vicinity of the Devon/Sterling and Albion mines were estimated using regional flood-frequency equations (Omang, 1992) and are presented in Table 2-1. The flood-frequency equations for the southwest region of Montana are based on the drainage area (0.494 square miles) and the percentage of the basin area that is above 6,000 feet in elevation (100 percent). The drainage area for the Devon/Sterling and Albion Mines is shown on Figure 2-3.

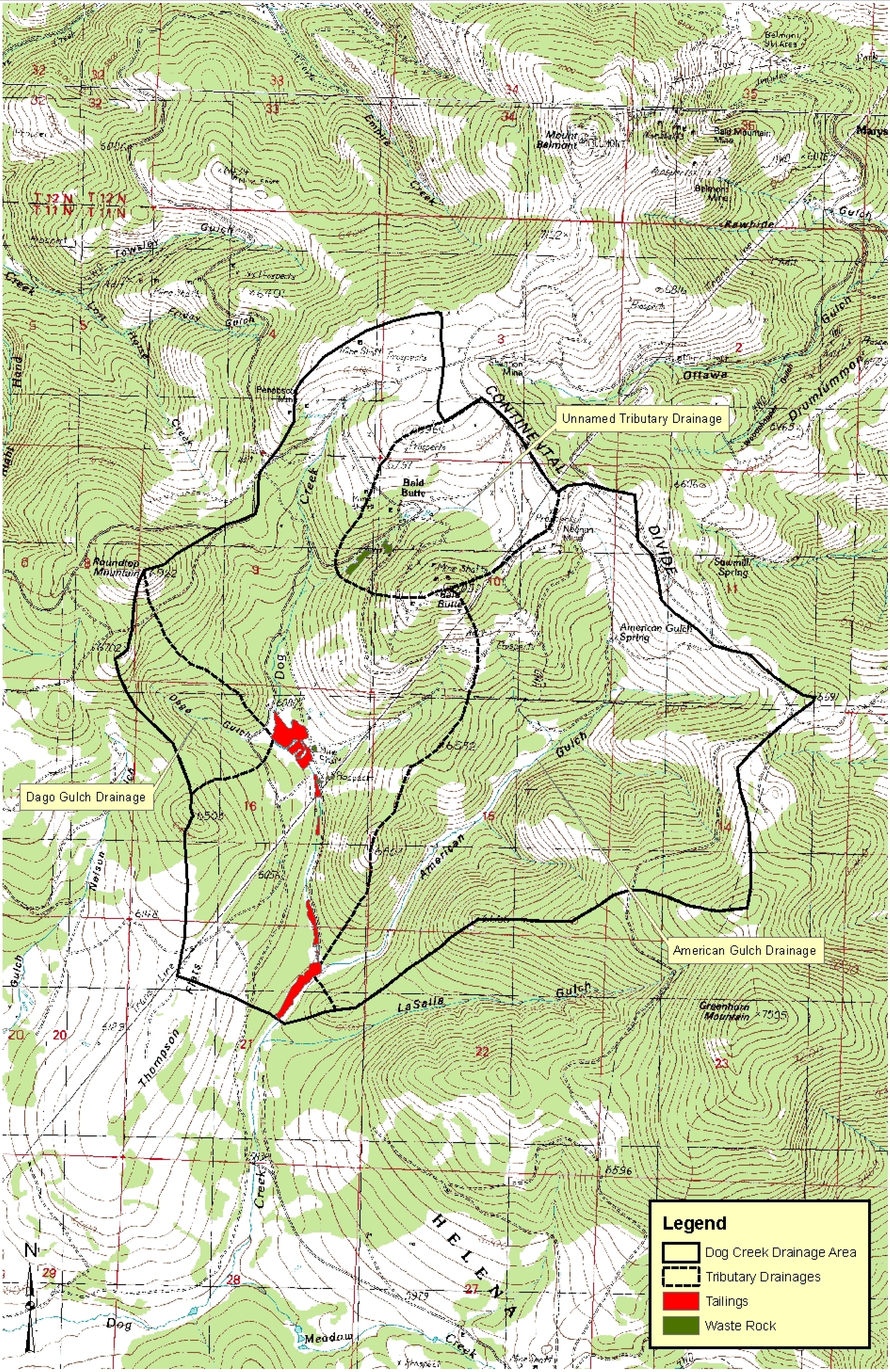


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Figure 2-3
Bald Butte Millsite and Devon/Sterling and Albion Mines Project Drainage Area Map

TABLE 2-1 ESTIMATES OF PEAK DISCHARGE FOR DOG CREEK AND THE UNNAMED TRIBUTARY TO DOG CREEK

Recurrence Interval (years)	Peak Discharge (cfs) by Regional Flood-Frequency Equations	
	Dog Creek at the Bald Butte Millsite	Unnamed Tributary at the Devon/Sterling and Albion Mines
2	24	3
5	44	7
10	64	10
25	96	18
50	119	23
100	144	29

In the area of the Bald Butte Millsite, Dog Creek flows through a narrow valley with steep side slopes. Elevation differences from the valley floor to the adjacent ridges are on the order of 500 to nearly 1,000 feet. The average stream gradient through the site area is approximately 2.5 percent. The average stream gradient above the site is approximately 6.5 percent.

In the area of the Devon/Sterling and Albion mines, the unnamed tributary flows through a narrow valley with steep side slopes. Elevation differences from the valley floor to the adjacent ridges are on the order of 400 to nearly 800 feet. The average stream gradient through the site area is approximately 14 percent.

2.4 CURRENT SITE SETTING

2.4.1 Location and Topography

The Bald Butte Millsite is located in the Marysville Mining District, Lewis and Clark County, Montana. The site is in the E ½ of Section 16 and NE ¼ of Section 21, Township 11 North, Range 6 West and the latitude and longitude are North 46° 42' 37" and West 112° 21' 19”. The site is located in the Dog Creek drainage. The elevation of the site ranges from approximately 5,900 feet below the tailings piles to 6,120 feet at the mill. The peaks on each side of Dog Creek, Round Mountain to the west and Bald Butte to the east, rise to elevations of 6962 feet and 7,052 feet, respectively. The Devon/Sterling and Albion mines are located in the Marysville Mining District, Lewis and Clark County, Montana. The mines are in the E ½ of Section 9 and NW¼ of Section 10, Township 11 North, Range 6 West and the latitude and longitude are North 46° 43' 21" and West 112° 20' 55”. The mines are located on an unnamed tributary in the Dog Creek drainage. The elevation of the mine sites range from approximately 6,180 feet at the intersection of the unnamed tributary and Dog Creek to 7,052 feet at the top of Bald Butte. The continental divide, which forms the northern boundary of the drainage basin, is located approximately two miles upstream from the tailings ponds and rises to an elevation of approximately 6,960 feet. The topography of the basin is mountainous and is mostly forested. The terrain surrounding the mines in the headwaters of the drainage basin is generally rugged, consisting of relatively steep slopes (15 to 20 degrees). The land is used for wildlife habitat, livestock grazing, and recreation. The town of Marysville is located approximately 3.5 air miles northeast of the site.

2.4.2 Vegetation/Wildlife

The area in the upper portions of the Dog Creek drainage is mostly continuously timbered with Lodgepole pine, Douglas fir, Engelmann spruce, and some Ponderosa pine. The area is important habitat for a variety of big game animals (mule deer, elk, moose, black bear), fur bearers (beaver and bobcat), waterfowl and birds. The area in the lower portion of the drainage is characterized by grass and range land.

The Montana Department of Fish, Wildlife and Parks (MDFWP) fisheries information contained in the Montana Fisheries Information System (MFISH) database (MDFWP, 2003) indicates that Dog Creek is 16.6 miles long and has the following Fisheries Resource Values (FRV):

	Fisheries Resource Values		
River Miles	Habitat Class	Sport Class	Final Value
0.0 to 11.5	3	4	Substantial
11.5 to 13.7	4	4	Moderate
13.7 to 16.6	5	4	Moderate

FRVs: 3 - Substantial
4 - Moderate
5 - Limited

The site is located in the stream reach between River Mile (RM) 13.7 to 16.6. According to the MFISH database, Brown Trout are year-round residents and are considered common in abundance from river miles 0 to 11.5. Brook Trout (RM 0-13.7), Brown Trout (RM11.5-13.7), Mountain Whitefish (RM 0-13.7) and Westslope Cutthroat Trout (RM 0-14.9) are year-round residents and are considered rare in abundance. Yellowstone Cutthroat Trout and Yellowstone/Westslope Cutthroat Trout hybrids are considered year-round residents, but their abundance is unknown. Bull Trout are considered rare in abundance, but their water usage is unknown. Based on the data quality descriptions provided, it appears that no surveys have been completed in the stream area. The data are listed as being extrapolated from surveys or based on professional judgment.

2.4.3 Historic or Archaeologically Significant Features

A cultural resource inventory and assessment was prepared for the Bald Butte Millsite in January 2003 (DEQ-MWCB/Frontier Historical Consultants, 2003). The study examined the site to determine: 1) what, if any, cultural resources were in the project area and 2) the significance of the identified resources in terms of the National Register of Historic Places (NRHP). One historic site was identified: the Bald Butte Mill (24LC1799), located on Dog Creek in the Marysville District. It includes large areas of mill tailings, stone mill foundations, a shaft with associated hoist house, log cabins and a dry-land dragline. The site covers parts of the Dry Creek (Dog Creek) and Cold Spring Placers as well as the Occidental, Springbrook, and Springbrook Fraction lodes and the Larson Lode and mill site.

The Bald Butte Millsite had two main periods of significance. The first period occurred from 1881 until 1902 when the nearby Bald Butte mine and the mill were at their peak of production. The second significant period was from 1931 to 1939 when lessees, on an intermittent basis, reworked the tailings to recover missed values.

The physical integrity of the site has diminished over time, however, a number of features from the site's initial period of significance remain and the dry-land dragline from the second period is relatively intact. The mine was an important producer during the 1880s and 1890s and thus was a significant factor in the area's mining history and contributed to the general pattern of mining history. The Bald Butte Mine, therefore, would qualify for inclusion to the NRHP under Criterion A. Inclusion under Criterion A requires that the site was associated with events that have made a significant contribution to the broad patterns of our history.

Inclusion to the NRHP under Criterion C requires that the site embodied the distinctive characteristics of a type, period, or method of construction, or that represented the work of a master, or that possesses high artistic values, or that represented a significant and distinguishable entity whose components may lack individual distinction. Due to the existence of the dragline and tailings, the site would also be eligible for the NRHP under Criterion C because it embodies the distinctive characteristics of a unique method of mining. The site's pattern of tailings also represents a significant entity even though the individual components lack distinction.

Although the mine complex was recommended to be individually eligible for the NRHP under criteria A and C, the Bald Butte Millsite was not recommended as a contributing element to the Marysville Mining District at this time. As one of the active mining sites in the district, the Bald Butte Mill was historically a contributing component of the Marysville Mining District. However, its contribution to the district at this date could not be evaluated. The integrity of the greater Marysville Mining District is not known and its significance has not been assessed. Since the Marysville Historic Mining District has not been officially been placed on the Register even though determined to be eligible for listing, and since the larger district's boundaries remain officially undefined, a determination of the site's contribution to the district could not be made.

No cultural resource inventory and assessment has been completed on the Devon/Sterling and Albion Mines site. No cultural resource inventory assessment has been completed on the area from tailings pile TP-3 to TP-6.

2.4.4 Land Use and Population

Land use in the site area has historically been a mining district. The area does provide some dispersed recreational use for hunters. The nearest population to the site area is the town of Marysville, approximately 3.5 air miles to the northeast. A cabin was observed near the headwaters of Dog Creek and a new cabin is being built in Dago Gulch southwest of the site. Upstream along the unnamed tributary, there are some seasonal cabins in the area of the historical Bald Butte townsite. Hiking, camping, ATV riding, hunting and fishing are most likely the principal recreational uses in the general area. Although much of the terrain is steep and forested, grazing cattle probably pass through the area. Ranching, timbering and, in the past, mining were the principal commercial uses of the land in the area.

2.4.5 Land Ownership

Land ownership in the area of the Bald Butte Millsite and Devon/Sterling and Albion Mines was compiled from the Montana Cadastral Mapping Project 2003 database. Figure 2-4 shows the location of the parcels and Table 2-2 provides a summary of the land ownership.

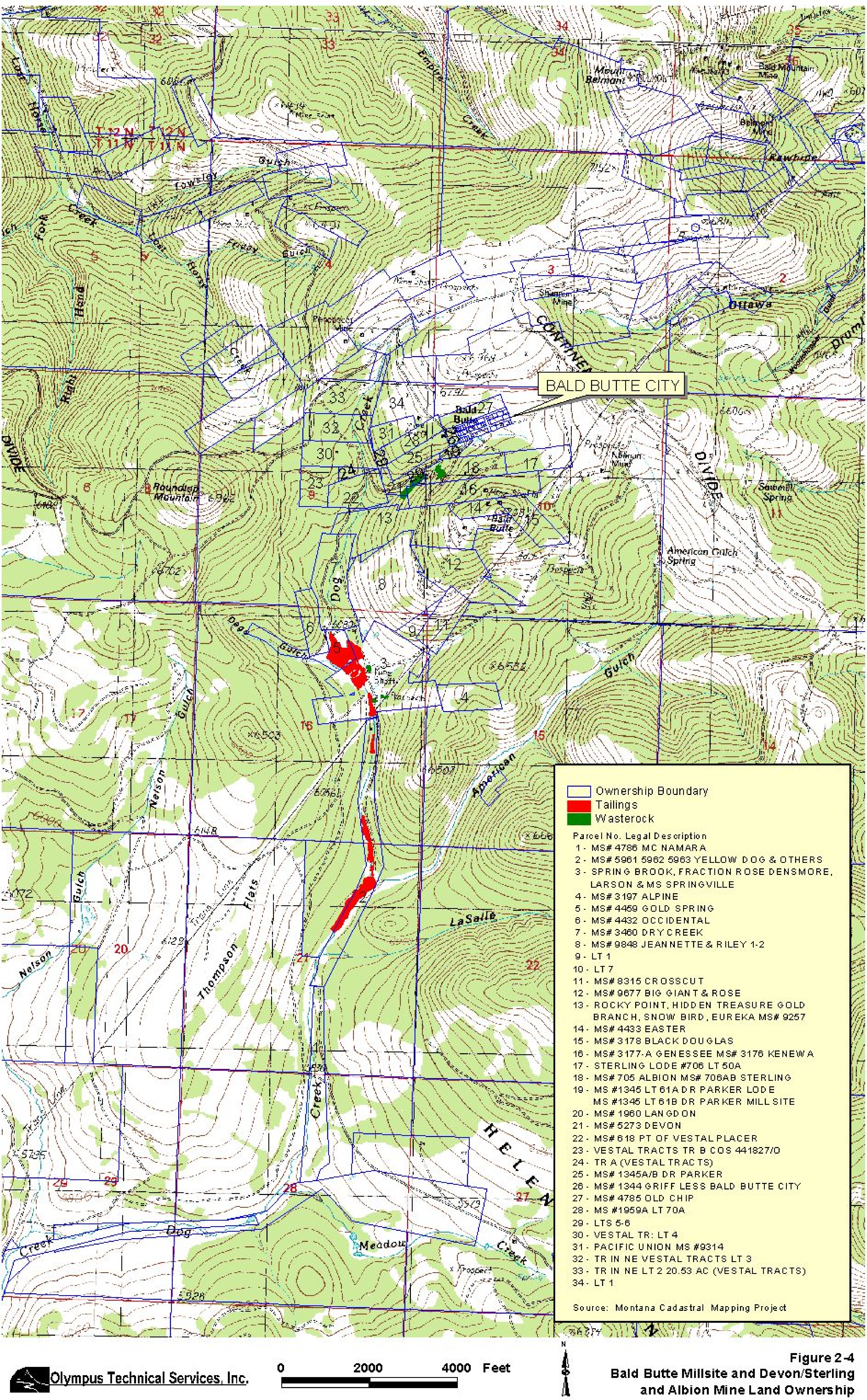

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Figure 2-4
Bald Butte Millsite and Devon/Sterling and Albion Mine Land Ownership

TABLE 2-2 SUMMARY OF LAND OWNERSHIP

No.	Parcel	Owner Name
1	MS# 4786 McNamara	Hartmut W. and Inga M. Baitis
2	MS3 5961 5962 5963 Yellow Dog & Others	Springfield Sportsman's Association
3	Spring Brook Fraction Rose Densmore, Larson & MS Springville	Springfield Sportsman's Association
4	MS# 3197 Alpine	Springfield Sportsman's Association
5	MS# 4459 Gold Spring	Verde Ltd. (Ryan and Ron Werner)
6	MS# 4432 Occidental	Hartmut W. and Inga M. Baitis
7	MS# 3460 Dry Creek	Hartmut W. and Inga M. Baitis
8	MS# 9848 Jeannette & Riley 1-2	Hartmut W. and Inga M. Baitis
9	LT 1	United States of America
10	LT2	United States of America
11	MS# 8315 Crosscut	Hartmut W. and Inga M. Baitis
12	MS#9677 Big Giant & Rose	Hartmut W. and Inga M. Baitis
13	Rocky Point, Hidden Treasure Gold Branch, Snow Bird, Eureka MS#9257	Hartmut W. and Inga M. Baitis
14	MS# 4433 Easter	Hartmut W. and Inga M. Baitis
15	MS# 3178 Black Douglas	Charles W. and Carolyn M. Byerly
16	MS# 3177 A Genessee, MS#3176 Kenewa	Hartmut W. and Inga M. Baitis
17	Sterling Lode #706 LT50A	Dianne L. Peters AKA Giesick
18	MS#705 Albion, MS#706AB Sterling	Hartmut W. and Inga M. Baitis
19	MS# 1345 LT 61A Dr Parker Lode MS# 1345 LT 61B Dr Parker Millsite	Harold G. and Barbara J. Adams
20	MS# 1960 Langdon	Hartmut W. and Inga M. Baitis
21	MS# 5273 Devon	Hartmut W. and Inga M. Baitis
22	MS# 618 PT Of Vestal Placer	Ed and Sharron Sendra
23	Vestal Tracts TR B COS 44182/O	Charles P. Manny and Dr. Ken Greene
24	TR A (Vestal Tracts)	Buddy and Judy Mergenthaler
25	MS# 1345 A/B Dr Parker	Hartmut W. and Inga M. Baitis
26	MS# 1344 Griff less Bald Butte City	Harold G. and Barbara J. Adams
27	MS# 4785 Old Chip	Hartmut W. and Inga M. Baitis
28	MS# 1959A LT 70A	Hartmut W. and Inga M. Baitis
29	LTS 5-6	United States of America
30	Vestal TR: LT4	Gregory Barton
31	Pacific Union MS# 9314	James H. Barfknecht
32	TR IN NE Vestal Tracts LT3	Arthur and John Dick (50% undiv) Hartmut W. and Inga M. Baitis (50% undiv)
33	TR in NE LT 2 20.53 AC (Vestal Tracts)	Hartmut W. and Inga M. Baitis
34	LT 1	United States of America

3.0 WASTE CHARACTERISTICS AND SUMMARY OF RECLAMATION INVESTIGATION

The objective of the Bald Butte Millsite and Devon/Sterling and Albion Mines site characterization was to evaluate the abandoned mine/mill wastes at the site while generating a database which met the requirements necessary to complete a risk assessment and detailed analysis of reclamation alternatives. The Site Characterization Report (DEQ-MWCB/Olympus, 2004) presents the results of the reclamation investigation activities. The data generated to support the two primary tasks are summarized as follows:

Risk Assessment Data Requirements:

- Establish background soil concentrations with at least 6 background samples;
- Characterize vertical and lateral metal concentration variations in waste sources and assess the 0 to 6 inches zone for direct contact and air emission potential;
- Evaluate the physical and chemical properties of the source material that may affect contaminant migration including: pH, metal concentrations, leaching potential, acid-base accounting and particle size distribution;
- Inventory solid and hazardous waste materials on site associated with past mining;
- Characterize impacts to shallow groundwater by conducting a limited groundwater assessment;
- Assess physical hazards associated with potential open adits or shafts, pits, trenches, highwalls and dilapidated structures, etc.; and
- Assess surface water and groundwater uses and estimate other ecological uses.

Feasibility Study Data Requirements Include:

- Determine accurate areas and volumes of the contaminant source materials including mill tailings and waste rock piles;
- Contaminant concentration variations and leaching characteristics of the waste sources;
- Representative acid-base accounting characteristics of the mill tailings and waste rock;
- Determine depth of shallow groundwater in potential repository area;
- Determine hydrologic configuration of the Dog Creek channel in the vicinity of the tailings piles;
- Determine physical characteristics and dimensions of open accesses to underground mine workings;
- Identification of potential borrow source areas for cover soil;

- Assess revegetation parameters for cover soil sources including soil texture and grain size, nitrogen, phosphorus, potassium, percent organic matter, pH and conductivity; and

- Determine optional locations and soil characteristics for repository site(s).

The principal techniques used for data acquisition in this site investigation were backhoe test pits and shovel/hand auger test holes, field mapping, soil, stream sediment and surface water sampling. Samples were collected using standard operating procedures that are contained in the Field Sampling Plans (DEQ-MWCB/Olympus, 2003a and 2003b) and were analyzed according to the Laboratory Analytical Protocol (DEQ-MWCB/Olympus, 2003d). Analytical data were evaluated for quality assurance according to the Quality Assurance Project Plan (DEQ-MWCB/Olympus, 2003e). The site characterization work was completed according to a health and safety plan (DEQ-MWCB/Olympus, 2003c).

The site characterization field program included collecting solids samples for the following types of analyses:

- Multi-element X-Ray Fluorescence (XRF) screening. XRF analyses were generally completed for all solid sampling intervals. The XRF analyses determined qualitative to semi-quantitative concentrations of the following elements: Ag, As, Ba, Ca, Cd, Co, CrVI, CrIII, Cu, Fe, Hg, K, Mn, Mo, Ni, Pb, Rb, Sb, Se, Sn, Sr, Ti, Th, U, Zn, and Zr.

- Target analyte list (TAL) for commercial laboratory. This includes total metals and non-metals analyses following the EPA Contract Lab Program (CLP) Methods for determining the concentrations of the following elements: Ag, As, Ba, Cd, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Sb, Zn. Reconnaissance stream sediments were analyzed for As, Cd, Cu, Hg, Pb, Sb and Zn. Both sample suites were also analyzed for total cyanide and paste pH. Laboratory analyses for the TAL were all performed at Northern Analytical Laboratories, Inc. in Billings, Montana.

- Acid-Base Accounting (ABA) analyses including determination of sulfur fractions and neutralization potential. These analyses were all performed at Northern Analytical Laboratories, Inc. in Billings, Montana.

- Hazardous waste characteristics, determined by analysis for Toxicity Characteristic Leaching Procedure (TCLP) metals analysis for the following elements: Ag, As, Ba, Cd, Cr, Hg, Pb, and Se. These analyses were performed at Northern Analytical Laboratories, Inc. in Billings, Montana.

- Potential borrow source characteristics including analyses for particle size distribution, pH, conductivity, saturation, organic matter and content of phosphorous, nitrogen, and potassium. These analyses were performed at Northern Analytical Laboratories, Inc. in Billings, Montana.

3.1 BACKGROUND SOIL SAMPLES

Six background soil samples were collected from the Bald Butte Millsite and Devon/Sterling and Albion Mines project area. The sample locations are shown on Figure 3-1. The samples were

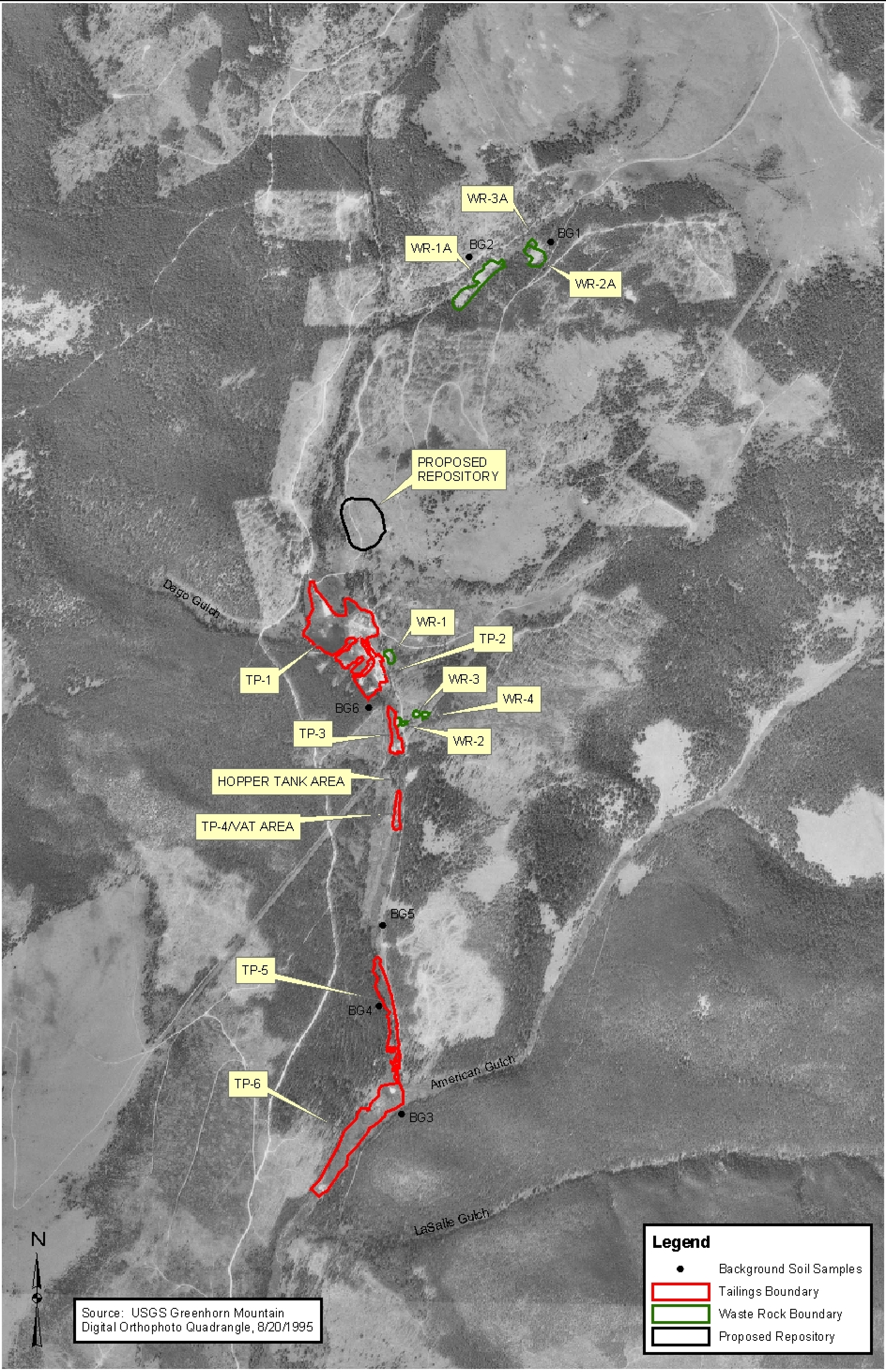

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Figure 3-1
Background Soil
Sample Locations

selected to provide representative coverage of the project area outside of known waste areas and other areas of disturbance. Sample locations were selected to be representative of soils derived from the country rock present in the area of the drainage basin.

Background soil samples were screened for a multi-element suite using a portable X-ray fluorescence (XRF) analyzer and the same samples were analyzed at Northern Analytical Laboratories, Inc. for pH and the following total metals: Ag, As, Ba, Cd, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Sb and Zn. The background soil qualitative to semi-quantitative XRF range and mean concentration results for the principal elements of interest are as follows: Ag (no detection), As (no detection), Ba (686.3 - 1,768.2 ppm and 1,115.1 ppm), Cd (no detection), Cr (no detection), Cu (no detection - 88.1 ppm and 62.9 ppm), Fe (15,003 - 24,570.3 ppm and 20,203.3 ppm), Hg (no detection), Mn (447.5 - 1,307.9 ppm and 794.3 ppm), Ni (no detection), Pb (no detection - 64 ppm and 35.9 ppm), Sb (no detection), and Zn (194.7 - 493.9 ppm and 355 ppm). The laboratory results for the background samples are presented in Table 3-1, with the mean concentrations summarized as follows:

Mean Background Soil Element Concentrations (quantitative laboratory results)
All Results in mg/kg

pH	Ag	As	Ba	Cd*	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Zn
5.03	ND	40.7	198	0.83	10.5	28.3	16,666.7	ND	793	9.2	44.3	ND	232

Notes: ND -No detection
**Cadmium only detected in 2 samples, at or just above detection limit*

3.2 MINE/MILL WASTE SOURCES

3.2.1 Tailings and Waste Rock Waste Characteristics

The site characterization report evaluated a number of mine/mill waste sources including six mill tailings and seven waste rock piles. In addition, approximately 1.8 miles of reconnaissance stream sediment sampling was completed from just downstream of tailings pile TP-2 to a point where the main access road to the Bald Butte Millsite crosses Dog Creek. Figure 1-1 is a map focusing on the overall Bald Butte Millsite and Devon/Sterling and Albion Mines project area and illustrates the major features, including the Dog Creek drainage and the associated tailings and waste rock piles that were investigated. The general information regarding each waste source, including area (if applicable), location, average thickness (if applicable), volume, number of test locations, number of XRF samples and number of composite laboratory samples is listed in Table 3-2. The following sections summarize the results of the site characterization report for each of the waste sources.

3.2.1.1 Tailings Pile TP-1 Volume, Geology and Chemistry

The tailings pile TP-1 is located in the NE¼ Section 16, Township 11 North and Range 6 West, Montana Principal Meridian (Figure 1-1 and 1-2). The tailings pile occurs within the Dog Creek and lower portion of the Dago Gulch drainage and floodplain. The tailings pile contains two water-filled ponds and a northwest to southeast tailings lobe located downstream from the

Table 3-1. Background Soil Laboratory Results

Sample ID	Paste pH	Ag (mg/Kg)	As (mg/Kg)	Ba (mg/Kg)	Cd (mg/Kg)	Cr (mg/Kg)	Cu (mg/Kg)	Fe (mg/Kg)	Hg (mg/Kg)	Mn (mg/Kg)	Ni (mg/Kg)	Pb (mg/Kg)	Sb (mg/Kg)	Zn (mg/Kg)
25-179-BG1	4.7	<5	37	118	2	14	37	15800	<1	284	8	81	<5	306
25-179-BG2	5.1	<5	<10	329	1	12	30	20200	<1	607	10	19	<5	301
25-179-BG3	5.6	<5	16	222	<1	8	23	13100	<1	661	10	31	<5	93
25-179-BG4	4.8	<5	32	142	<1	9	26	12800	<1	1400	7	31	<5	169
25-179-BG5	5.0	<5	82	228	<1	9	29	19300	<1	1320	9	22	<5	175
25-179-BG6	5.0	<5	72	149	<1	11	25	18800	<1	486	11	82	<5	348
Maximum	5.6	<5	82	329	2	14	37	20200	<1	1400	11	82	<5	348
Minimum	4.7	<5	<10	118	<1	8	23	12800	<1	284	7	19	<5	93
Mean	5.03		40.7	198.0		10.5	28.3	16666.7		793.0	9.2	44.3		232.0
n	6	6	6	6	6	6	6	6	6	6	6	6	6	6

LEGEND

25-179-BG1	Located to NE of Albion Mine waste rock and upslope in area with no evidence of disturbance
25-179-BG2	Collected to NW of Devon/Sterling waste rock pile WR1A up the ridge above the access road
25-179-BG3	Collected up ridge on east side of beaver pond outside of tailings pile TP6 area; logging road upslope approximately 25 feet
25-179-BG4	Located on west side of Dog Creek on topographic bench located on ridge above drainage bottom area containing TP5 tailings area
25-179-BG5	Located approximately 35' up the ridge from former logging road above Dog Creek on east side
25-179-BG6	Located on westside of TP3 up ridge in undisturbed area

Note: Statistics - one half the lower detection limit is used where below detection limit samples are included in the mean calculation

Pioneer Technical Services, Inc. Background Sample

Sample ID	Paste pH	As (mg/Kg)	Ba (mg/Kg)	Cd (mg/Kg)	Co (mg/Kg)	Cr (mg/Kg)	Cu (mg/Kg)	Fe (mg/Kg)	Hg (mg/Kg)	Mn (mg/Kg)	Ni (mg/Kg)	Pb (mg/Kg)	Sb (mg/Kg)	Zn (mg/Kg)
BACKGROUND		51.1 J	290 J	1.9	5.21	8.25	82.4 J	7590 J	0.109 J	2390 J	4.81	139 J	10.2 U	190 J

Note: BACKGROUND collected from the Wild Cat Mine (PA # 25-317-SS-1) area for the Bald Butte Millsite preliminary assessment

Table 3-2. Summary of General Information for Bald Butte Millsite and Devon/Sterling and Albion Mines Waste Sources

Waste Source Identification	Area (Acres)	Location (Section, Township, Range)	Average Thickness Estimated (feet)	Waste Volume (cubic yards)	Test Locations[1]	XRF Samples	Laboratory Composite Samples
Bald Butte Millsite Tailings Subarea 1	12.64	NE¼ and SE¼, Sec 16, T11N, R6W					
TP-1	9.03		3.1	43,460	50	38	4
TP-2	2.08		2.2	7,440	18	15	4
TP-3	1.00		2.0	3,270	10	6	2
TP-4/Vat Leach/Hopper Tank	0.53		0.5	510	15	16	3
Bald Butte Millsite Tailings Subarea 2	9.26	SE¼, Sec 16 and NE¼, Sec 21, T11N, R6W					
TP-5	2.62		0.6-1.1*	2,400 to 4,700*	27	15	3
TP-6	6.64		1.0	11,170	28	15	4
Bald Butte Millsite Tailings Waste Rock	0.63	NE¼, Sec 16, T11N, R6W					
WR-1	0.26		2.0	850	4	4	2
WR-2	0.18		3.0	826	5	5	2
WR-3	0.10		5.05	848	5	5	2
WR-4	0.09		2.4	350	4	4	1
Devon/Sterling and Albion Mines Waste Rock	2.91	NE¼, Sec 9 and NW¼, Sec 10, T11N, R6W					
WR1A	2.0		6.8	21,900	6	6	2
WR2A	0.78		8.5	10,660	5	5	2
WR3A	0.13		1.8	380	3	3	1

[1]Test locations may include one or more of the following methods: backhoe test pit, shovel test pit or hand auger boring

* Two methods Eagle Point surface model and block model, respectively

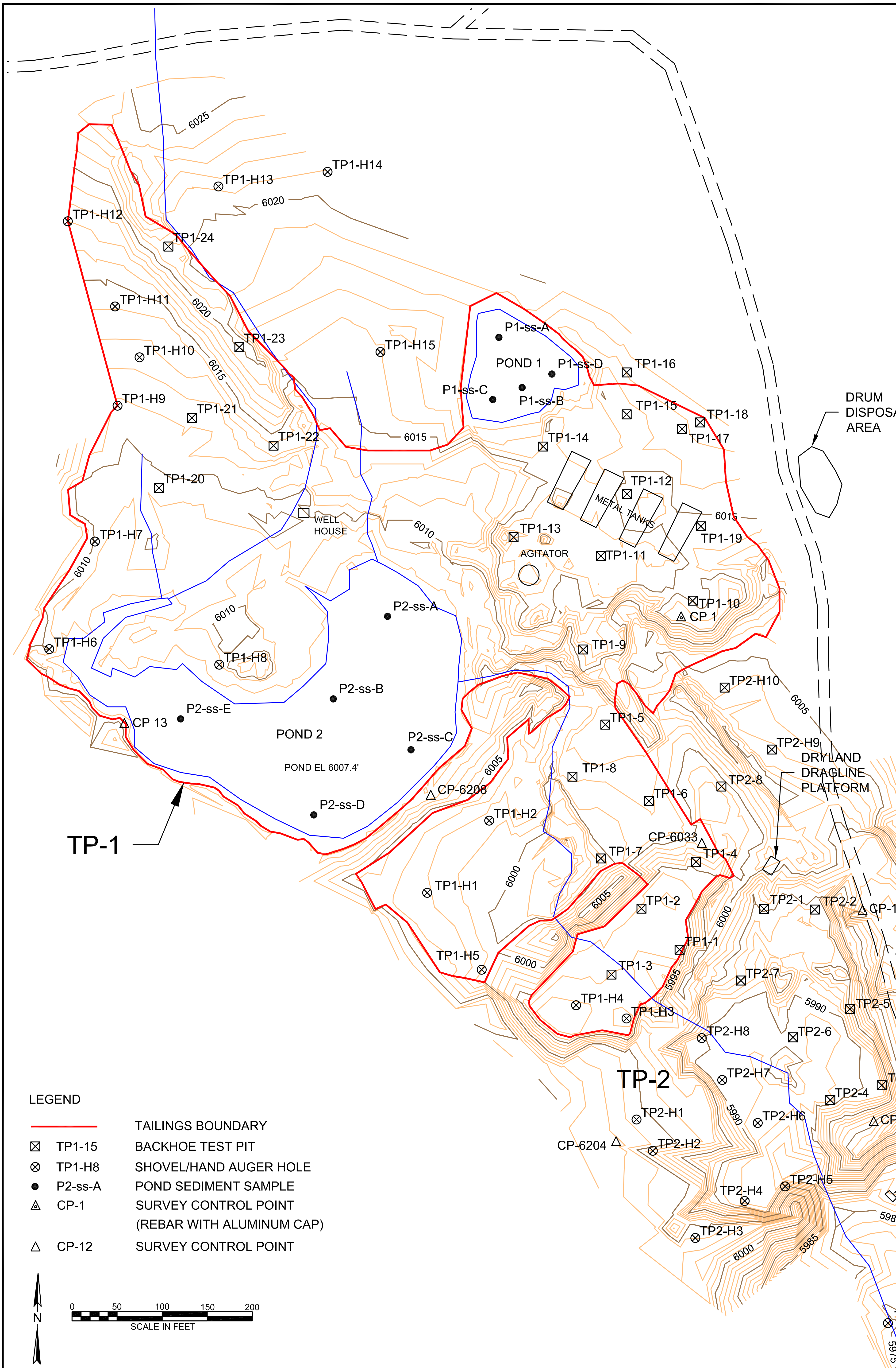
former Bald Butte millsite. The reconstructed operating history in the tailings pile TP-1 area indicates that these tailings were subjected to multiple precious metal reprocessing efforts via cyanide vat leaching (Frontier Historical Consultants, 2003).

Dog Creek and its tributary Dago Gulch flow into the main tailings pond. Water discharges from this pond via a breach in the main dam and flows as Dog Creek downstream through breaches in other dams that served as tailings impoundments within the drainage. Vegetation in the TP-1 area is highly variable from nil to moderately abundant. Grasses and willows are the dominant vegetation. A map showing the TP-1 tailings pile area is presented in Figure 3-2. The TP-1 tailings volume was estimated using the detailed topographic survey of the tailings surface and the test pit data. The volume estimate methods are detailed in the Bald Butte Millsite and Devon/Sterling and Albion Mines site characterization report (DEQ-MWCB/Olympus, 2004). A total volume estimate for the mill tailings contained in the TP-1 area is 43,460 cubic yards (cy). The tailings plan area is 9.03 acres and the average and maximum tailings thickness are 3.1 and 13 feet, respectively.

The TP-1 tailings pile geology is based on observations made from 50 test holes (Figure 3-2). All of the backhoe and shovel/hand auger test holes intercepted native soil with the exception of backhoe test pit TP1-5 and shovel/hand auger holes TP1-H1 and TP1-H8. The holes were collapsing due to saturation of the tailings. The upper zone of the tailings pile is comprised predominantly of tan to greenish tan silty sand. Some zones contain fine to medium-grained sand with minor silt. The upper zones of the tailings generally show variable oxidation evidenced by orange brown to reddish brown iron oxide (FeOx). The deeper tailings zones are generally unoxidized and composed of bluish gray, sandy silt to silty clay slimes with lesser dark tan silty clay to clayey silt. These finer grained tailings zones are generally moist to saturated. The deeper bluish gray slime zones at the Bald Butte tailings generally contain more sand fraction than most tailings pile slime zones. Particle size analyses for representative samples of tan fine-grained sand and bluish gray sandy silt tailings from TP-1 indicate that these tailings are silty sand and sandy silt with 12.5% clay, respectively (Table 3-3).

Nine sediment cores were collected in the top layer of the bottom sediment to assess the geology and chemistry of the pond sediment. Sediment cores were generally collected to 1.5 feet depth below the base of the water column. At the time of sampling, pond water depths ranged from 0.5 feet to 2.0 feet. The larger pond, Pond 2, contains fish (presumably trout) generally less than six inches in length. Pond 1 contains some solid waste in the form of wood and metal debris, minor glass, campstove propane bottles and a single truck tire. The pond sediment consists of dark green to black silty clay with variable organic matter. Some minor gravel and/or rock were intersected in Pond 1. It is believed the tailings sediment in Pond 1 is not very thick. None of the shallow sediment cores collected in Pond 2 appeared to reach native soil. Based on test pits and hand auger holes completed in TP-1 near the perimeter of Pond 2, there is probably a significant thickness of tailings forming the bottom sediment in Pond 2.

The native soils intersected in the test pits generally consist of dark brown to black silty loam with variable gravel and/or rock. The material resembles topsoil. Contact with the tailings is commonly very sharp and there is nil to minor FeOx. The native soils vary from dry to moist and in some cases, may be saturated.



Olympus Technical Services, Inc.

MONTANA DEQ/MINE WASTE CLEANUP BUREAU
BALD BUTTE MILLSITE AND MINES
LEWIS & CLARK COUNTY, MONTANA

TAILINGS PILE TP-1 MAP

FIGURE 3-2

DESIGN:	DRAWN: KSR	CHECKED: CRS	APPROVED:	DATE: 12/2003	JOB NO: A1371	SCALE: AS SHOWN	FILENAME: A1432BButte.dwg

Table 3-3. Mill Tailings Particle Size Results

Sample ID	Weight Percent Retained					Percent Finer by Weight								
	Gravel	Sand			Silt/Clay	Gravel	Sand			Silt/Clay				
Sieve Size	3/4-in	#4	#10	#40	#200	3/4-in	#4	#10	#40	#200	Percent	Percent	Percent	Soil
Opening (Inches)	0.75	0.187	0.0661	0.0106	0.0029	0.75	0.187	0.0661	0.0106	0.0029	Sand	Silt	Clay	Texture
25-179-TP1-3	3.1	13.8	1.7	23.8	41.7	96.9	83.1	81.4	57.6	15.9	65.0	30.0	5.0	Sandy Loam
25-179-TP1-4	0	0	0.1	26.7	39.2	100	100	99.9	73.2	34.0	42.5	45.0	12.5	Loam
25-179-TP2-1	0	29.1	12.1	10.5	31.7	100	70.9	58.8	48.3	16.6	55.0	35.0	10.0	Sandy Loam
25-179-TP2-2	0	18.4	3.6	53.3	13.8	100	81.6	78	24.7	10.9	22.5	52.5	25.0	Silty Loam
25-179-TP2-3	4	2.6	4.6	43	17.1	96	93.4	88.8	45.8	28.7	16.3	78.8	5.0	Silty Loam
25-179-TP3-1	3.9	41.7	3.4	12.7	24.3	96.1	54.4	51	38.3	14	45.0	47.5	7.5	Loam
25-179-TP3-2	0	0	0	34	45.3	100	100	100	66	20.7	25.0	55.0	20.0	Silty Loam
25-179-TP4-1	5	11.4	3.6	3.7	66.9	95	83.6	80	76.3	9.4	85.0	12.5	2.5	Loamy Sand
25-179-TP5-1	0	8.7	4.3	11.7	34.3	100	91.3	87	75.3	41	60.0	32.5J	7.5	Sandy Loam
25-179-TP5-2	0	0	7.8	25.6	41.2	100	100	92.2	66.6	25.4	45.0	45.0	10.0	Loam
25-179-TP5-3	0.5	16.3	22.2	6.9	37.6	99.5	83.2	61	54.1	16.5	70.0	27.5	2.5	Sandy Loam
25-179-TP6-1	0	15.9	1.6	37.2	26.8	100	84.1	82.5	45.3	18.5	67.5	27.5	5.0	Sandy Loam
25-179-TP6-2	0	0	0.9	22.1	48.7	100	100	99.1	77	28.3	52.5	42.5	5.0	Sandy Loam
25-179-TP6-3	0	0	0	63.6	25.9	100	100	100	36.4	10.5	10.0	32.5	57.5	Clay
25-179-TP7-1	0	4.7	3.4	7.3	58.8	100	95.3	91.9	84.6	25.8	75.0	22.5	2.5	Loamy Sand

LEGEND

25-179-TP1-3 is a composite of TP1-4-0.4-2.0, TP1-8-0.1-2.8, TP1-12-0-1.5, and TP1-23-0-4.2; tan fine-grained sandy
25-179-TP1-4 is a composite of TP1-1-1.6-3.5, TP1-2-1.7-2.7, TP1-5-3.0-5.0, and TP1-8-2.8-6.6; bluish gray sandy, silty
25-179-TP2-1 is a composite of TP2-2-0-0.9 and TP2-8-0-1.3; tan fine-grained sandy tails
25-179-TP2-2 is a composite of TP2-3-0-1.1 and TP2-6-0.4-1.5; tan silty clay tails
25-179-TP2-3 is a composite of TP2-4-2.1-3.1 and TP2-7-0.5-3.0; blue-gray slimes
25-179-TP3-1 is a composite of TP3-1-0.2-4.7 and TP3-2-0.9-3.4; tan sandy and dark green-gray sandy tailings
25-179-TP3-2 is a composite of TP3-1-4.7-7.5 and TP3-H2-0.5-3.8; bluish gray and dark green clayey silt tailings
25-179-TP4-1 is a split of XRF sample TP4-2
25-179-TP5-1 is a composite of TP5-2-0.1-0.7, TP5-H5-0-0.5 and TP5-H10-0.1-1.6; light brown fine-grained sand tailings w/minor FeOx
25-179-TP5-2 is a composite of TP5-H15-0.1-2.6 and TP5-H16-0.2-2.6; gray-bluish green fine-grained sand tailings
25-179-TP5-3 is a composite of TP5-3-0-0.5, TP5-H3-0-1.3 and TP5-H14-0.1-2.5; tan silty sand tailings w/FeOx
25-179-TP6-1 is a composite TP6-H1-0-1.8, TP6-H2-0.2-1.4, TP6-H3-0.3-1.9 and TP6-H20-0-3.9; tan sand tails; nil to varied FeOx
25-179-TP6-2 is a composite TP6-H8-0.5-1.8, TP6-H12-0.3-4.4, TP6-H14-0.2-3.0 and TP6-H18-0.1-3.4; bluish gray sand tailings
25-179-TP6-3 is a composite TP6-H10-0.3-1.9 and TP6-H15-0.4-1.0; gray clayey silt tailings
25-179-TP7-1 is a duplicate of 25-179-TP6-1

Representative samples for chemical analyses were collected from vertical channel samples taken from test pit walls, from grab samples collected from test pit excavation stockpiles or from hand auger soil cores. Individual samples were collected based on similar geologic characteristics. Thirty three tailings samples and four representative composite tailings samples were collected from the TP-1 tailings area for XRF screening. In addition, five native soil samples and one composite native soil sample were collected for XRF screening. The TP-1 tailings qualitative to semi-quantitative XRF range and mean concentration results for the elements of interest are as follows: Ag (no detection), As (28.6 - 342.7 ppm and 121.5 ppm), Ba (889.8 - 1,946.8 ppm and 1,383.9 ppm), Cd (no detection), Cr (no detection), Cu (109 - 583.9 ppm and 370.7 ppm), Fe (5,817.5 - 24,559.8 ppm and 12,665 ppm), Hg (no detection), Mn (131.4 - 988.4 ppm and 581.8 ppm), Ni (no detections), Pb (96.3 - 2,367.1 ppm and 1,184.6 ppm), Sb (no detection), and Zn (276.4 - 3,012.7 ppm and 1,549.5 ppm).

Laboratory analytical data for the four composite samples collected from the TP-1 tailings area are summarized in Table 3-4. The tailings pH is slightly acidic to alkaline ranging from 6.9 to 7.4 standard units (SU). The mean concentrations and the mean concentrations relative to background mean concentrations for analytes are summarized below. The mean concentrations from the laboratory quantitative analyses on representative composite samples generally corroborate the XRF screening mean concentration results with the exception of Ag, Cd, Hg, Ni and Sb which were not detected and Ba is significantly higher via XRF.

TP-1 Tailings Mean Element Concentrations Compared to Background (quantitative laboratory results)

All Results in mg/kg

Ag	As	Ba	Cd	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Zn	T CN
6.1	123.8	129.8	11.5	17.5	498.5	15,252.5	6.13	614.5	8.4	1,297.8	21.5	1,798.3	3.64
>2.4x	*3.0x*	*0.66x*	*>13.8x*	*1.7x*	*17.6x*	*0.9x*	*>12.3x*	*0.8x*	*0.9x*	*29.3x*	*>8.6x*	*7.8x*	

Note *Analytes Ag, Cd, and Hg were analyzed but not detected in background samples;*
½ detection limit used for statistics
Total cyanide was not analyzed in background soil

The analytes with an average concentration greater than or equal to three times the average background soil concentration include: As, Cd, Cu, Hg, Pb, Sb and Zn. Although total cyanide was not compared to average background soil because the parameter was not analyzed in these soils, the tailings mean concentration of 3.64 mg/Kg and a maximum concentration of 5.5 mg/Kg are elevated.

The native soil samples were collected below the tailings and analyzed via XRF and a representative composite sample was laboratory analyzed for the same suite of analytes as done on the tailings. The results suggest that As, Cd, Cu, Hg, Pb and Zn are leaching into the native soils below the tailings pile even though there appears to be minor to nil FeOx below the contact zone. The iron chemistry results indicate that iron is essentially at background soil concentration.

TABLE 3-4. Laboratory Chemistry Results For Mill Tailings, Selected Subgrade Native Soils and Drum Disposal Area

Sample ID	pH (SU)	Ag (mg/Kg)	As (mg/Kg)	Ba (mg/Kg)	Cd (mg/Kg)	Cr (mg/Kg)	Cu (mg/Kg)	Fe (mg/Kg)	Hg (mg/Kg)	Mn (mg/Kg)	Ni (mg/Kg)	Pb (mg/Kg)	Sb (mg/Kg)	Zn (mg/Kg)	Total Cyanide (mg/Kg)	Comments
Tailings Pile TP1																
25-179-TP1-1	7.4	<5	60	188	7	29	534	24500	3.7	831	18	1020	31	1590	<0.5	Composite of Pond1-ss-A, B, C and D; dark green to black silty clay
25-179-TP1-2	7.4	7	150	120	18	22	607	17800	6.6	788	7	1900	19	2630	4.6	Composite of Pond2-ss-A, B, C, D and E; black to lt. green to gray silty clay
25-179-TP1-3	6.9	7	137	85	5	8	302	7510	5.5	352	<5	891	18	773	4.2J	Composite of TP1-4-0.4-2.0, TP1-8-0.1-2.8, TP1-12-0-1.5, and TP1-23-0-4.2; tan fn gr sandy
25-179-TP1-4	7.4	8	148	126	16	11	551	11200	8.7	487	6	1380	18	2200	5.5J	Composite of TP1-1-1.6-3.5, TP1-2-1.7-2.7, TP1-5-3.0-5.0, and TP1-8-2.8-6.6; bluish gry sandy, silty
Maximum	7.4	8	150	188	18	29	607	24500	8.7	831	18	1900	31	2630	4.6	
Minimum	6.9	<5	60	85	5	8	302	7510	3.7	352	<5	891	18	773	<0.5	
Mean	7.28	6.1	123.8	129.8	11.5	17.5	498.5	15252.5	6.13	614.5	8.4	1297.8	21.5	1798.3	3.64	
No. Samples	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
Tailings Pile TP1 Subgrade Native Soil																
25-179-TP1-5	6.1	75	286	178	12	13	499	27200	1.2	6900	16	1900	75	2190	2.5J	Composite of TP1-2-2.7-4.1, TP1-4-2.0-3.0, TP1-13-8.0-9.4, TP1-22-4.6-5.7; native soil beneath tails
Tailings Pile TP2																
25-179-TP2-1	6.5	11	129	84	10	11	721	13600	3.7	874	6	1460	11	1590	<0.5J	Composite of TP2-2-0-0.9 and TP2-8-0-1.3; tan fn gr sandy tails
25-179-TP2-2	6.3	17	222	103	13	16	803	17200	12	804	8	2050	22	2200	2.4J	Composite of TP2-3-0-1.1 and TP2-6-0.4-1.5; tan silty clay tails
25-179-TP2-3	7.4	19	231	122	20	16	969	12600	10	529J	10	2380	23	3250	24J	Composite of TP2-4-2.1-3.1 and TP2-7-0.5-3.0; blue-gray slimes
Maximum	7.4	19	231	122	20	16	969	17200	12	874	10	2380	23	3250	24	
Minimum	6.3	11	129	84	10	11	721	12600	3.7	804	6	1460	11	1590	<0.5	
Mean	6.73	15.7	194.0	103.0	14.3	14.3	831.0	14466.7	8.57	839.0	8.0	1963.3	18.7	2346.7	8.88	
No. Samples	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
Tailings Pile TP2 Subgrade Native Soil																
25-179-TP2-4	6.3	<5	216	136	8.0	17	130	28300	<1	1100	16	204	<5	1340	1.4J	Composite of TP2-3-1.1-2.0, TP2-4-3.1-3.8 and TP2-6-1.5-2.4; native soil below tailings
Tailings Pile TP3																
25-179-TP3-1	6.3	8	251	140	13	11	608	14800	3.4	6280	10	2280	59	2140	0.64J	Composite of TP3-1-0.2-4.7 and TP3-2-0.9-3.4; tan sandy and drk grn-gry sandy tailings
25-179-TP3-2	7.0	12	137	136	15	13	760	16300	6.3	3830	10	2180	51	2340	<0.50J	Composite of TP3-1-4.7-7.5 and TP3-H2-0.5-3.8; bluish gry and drk grn clayey silt tailings
Maximum	7.0	12	251	140	15	13	760	16300	6.3	6280	10	2280	59	2340	0.64	
Minimum	6.3	8	137	136	13	11	608	14800	3.4	3830	10	2180	51	2140	<0.50	
Mean	6.65	10.0	194.0	138.0	14.0	12.0	684.0	15550.0	4.85	5055.0	10.0	2230.0	55.0	2240.0	0.445	
No. Samples	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
Tailings Pile TP4 and Vat Leach/Hopper Tank Area																
25-179-TP4-1	6.6	<5	163	98	22	7	840	13100	4.6	589	<5	636	11	2970	<0.50J	Split of XRF sample TP4-2
25-179-VL-1	6.7	<5	135	219	22	29	1010	28000	7.6	897	12	2670	20	3740	4.2	Composite of tailings VL-ss-B, D, E and F
Maximum	6.7	<5	163	219	22	29	1010	28000	7.6	897	12	2670	20	3740	4.2	
Minimum	6.6	<5	135	98	22	7	840	13100	4.6	589	<5	636	11	2970	<0.05J	
Mean	6.65		149.0	158.5	22.0	18.0	925.0	20550.0	6.10	743.0	7.3	1653.0	15.5	3355.0	2.11	
No. Samples	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
Vat Leach/Hopper Tank Area Subgrade Native Soil																
25-179-VL-2	6.1	<5	81	258	11	23	535	22000	2.9	956	23	601	8	1610	3.9	Composite of native soil below tailings VL-ss-C1, D1 and E1

TABLE 3-4. Laboratory Chemistry Results For Mill Tailings, Selected Subgrade Native Soils and Drum Disposal Area

Sample ID	pH (SU)	Ag (mg/Kg)	As (mg/Kg)	Ba (mg/Kg)	Cd (mg/Kg)	Cr (mg/Kg)	Cu (mg/Kg)	Fe (mg/Kg)	Hg (mg/Kg)	Mn (mg/Kg)	Ni (mg/Kg)	Pb (mg/Kg)	Sb (mg/Kg)	Zn (mg/Kg)	Total Cyanide (mg/Kg)	Comments
Tailings Pile TP5																
25-179-TP5-1	6.6	25	358	100	19	7	1300	17900	13	14500	<5	4900	157	3260	1.6J	Composite of TP5-2-0.1-0.7, TP5-H5-0-0.5 and TP5-H10-0.1-1.6; lt brn fn gr sand tailings w/minor FeOx
25-179-TP5-2	6.3	9	188	140	22	11	856	16100	3.9	2730	8	1610	24	3030	<0.50J	Composite of TP5-H15-0.1-2.6 and TP5-H16-0.2-2.6; gry- bluish gr fn gr sand tailings
25-179-TP5-3	6.4	11	207	111	5	8	576	11300	8.4	405	<5	1210	21	725	<0.50J	Composite of TP5-3-0-0.5, TP5-H3-0-1.3 and TP5-H14-0.1-2.5; tan silty sand tailings w/FeOx
Maximum	6.6	25	358	140	22	11	1300	17900	13	14500		4900	157	3260		
Minimum	6.3	9	188	100	5	7	576	11300	4	405		1210	21	725		
Mean	6.43	15.0	251.0	117.0	15.3	8.7	910.7	15100.0	8.4	5878.3		2573.3	67.3	2338.3		
No. Samples	3	3	3	3	3	3	3	3	3	3		3	3	3		
Tailings Pile TP6																
25-179-TP6-1	6.3	8	157	114	20	8	807	11700	3.5	534	5	1230	16	2700	<0.50UJ	Composite TP6-H1-0-1.8, TP6-H2-0.2-1.4, TP6-H3-0.3-1.9 and TP6-H20-0-3.9; tan sand tails; nil to vari FeOx
25-179-TP6-2	6.2	13	119	96	14	8	721	10800	6.2	3840	<5	2100	59	2240	<0.50UJ	Composite TP6-H8-0.5-1.8, TP6-H12-0.3-4.4, TP6-H14-0.2-3.0 and TP6-H18-0.1-3.4; bluish gry sand tailings
25-179-TP6-3	5.0	<5	27	354	<1	12	47	9310	<1	113	13	37	<5	88	<0.50	Composite TP6-H10-0.3-1.9 and TP6-H15-0.4-1.0; gry clayey silt tailings
25-179-TP7-1	6.4	7	136	107	21	8	705	10800	3.7	526	5	1010	13	2840	<0.50	Duplicate of 25-179-TP6-1
Maximum	6.4	13	157	354	21	12	807	11700	6.2	3840	13	2100	59	2840		
Minimum	5.0	<5	27	96	<1	8	47	9310	<1	113	<5	37	<5	88		
Mean	5.98	7.6	109.8	167.8	13.9	9.0	570.0	10652.5	3.5	1253.3	6.4	1094.3	22.6	1967.0		
No. Samples	4	4	4	4	4	4	4	4	4	4	4	4	4	4		
Drum Disposal Area																
25-179-DASS-1	7.5	<5	202	49	10	10	234	13600	618	6.3	540	6	7	3590	95	Composite soil sample from 4 points in cyanide drum disposal area

Note: Statistics - one half the lower detection limit is used where below detection limit samples are included in the mean calculation

3.2.1.2 Tailings Pile TP-2 Volume, Geology and Chemistry

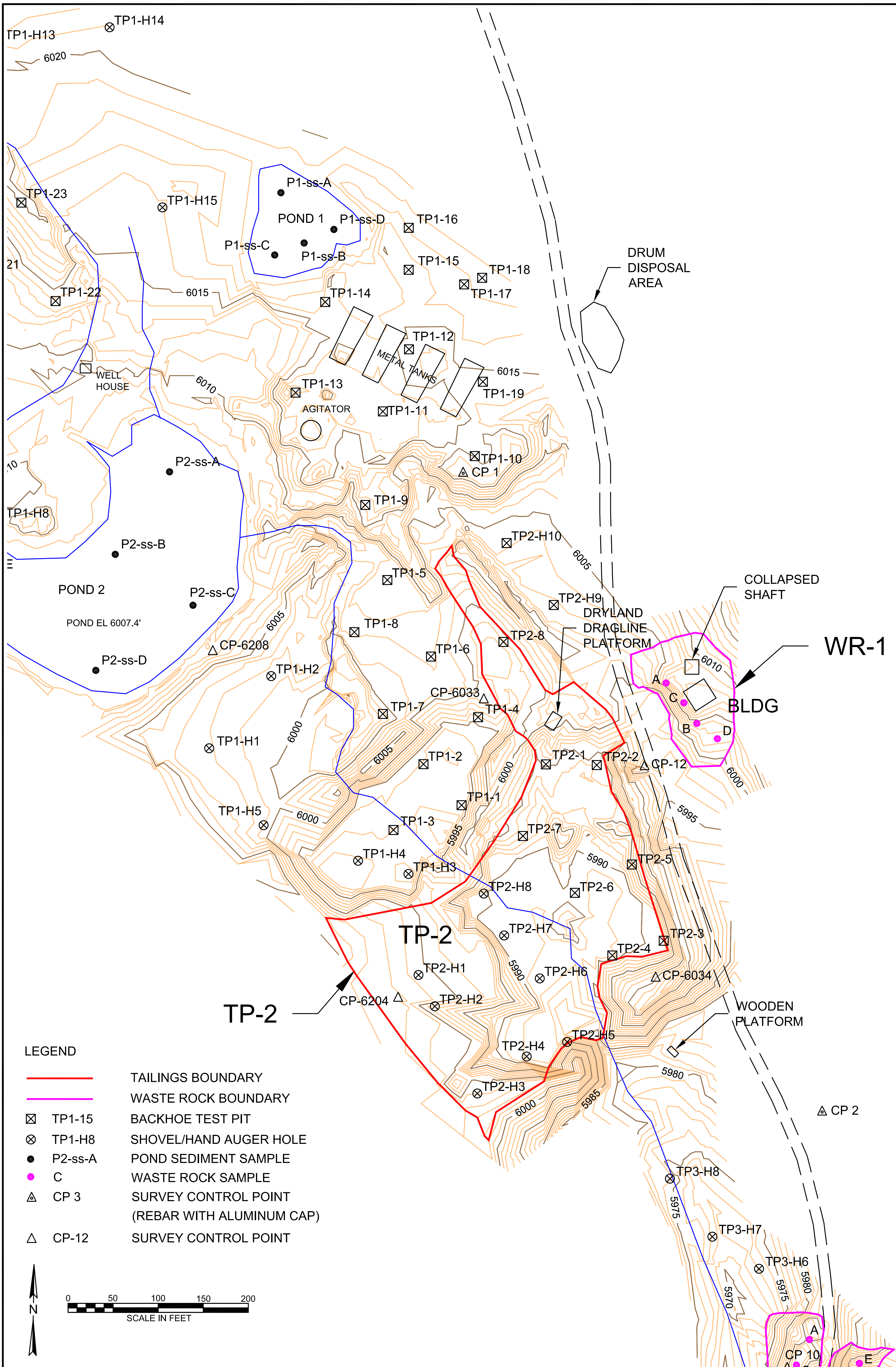
Tailings pile TP-2 is located in the NE¼ Section 16, Township 11 North and Range 6 West, Montana Principal Meridian (Figure 1-1 and 1-2). The TP-2 tailings area is located to the southwest of TP-1 immediately downstream along the present Dog Creek channel. The topography, test pit locations and details of the TP-2 area are presented in the map on Figure 3-3. This tailings pile has been extensively reworked during tailings reprocessing operations. The wooden base structure from a dry-land dragline is located in the TP-2 area. The tailings are generally devoid of vegetation except in `areas of fine-grained tailings that exhibit water holding capacity. These areas generally have sedge-type grasses indicative of wetlands environments. Field evidence indicates that the TP-2 area is a popular off-road driving area for ATV/motorcycle use. The TP-2 tailings are complex because of secondary disturbances related to 1) secondary mining and reprocessing and, 2) sediment erosion caused by storm water and snowmelt runoff.

The TP-2 tailings volume was estimated using the detailed topographic survey of the tailings surface and the test pit data (Figure 3-3). A total of 18 backhoe test pits and shovel/hand auger holes were excavated in the tailings area. The volume estimate method is detailed in the Bald Butte Millsite and Devon/Sterling and Albion Mines site characterization report (DEQ-MWCB/Olympus, 2004). The estimated volume of the tailings pile is 7,440 cubic yards. The tailings plan area is 2.08 acres and the average tailings depth is 2.2 feet. The maximum tailings thickness measured in the test pits was 12 feet.

The tailings contained in the TP-2 area are predominantly tan to greenish tan silty sands with lesser clayey silts. The tailings are commonly oxidized and contain yellow to orange brown FeOx in some of the shallower tailings zones. When present, bluish gray, non-oxidized tailings slimes are located at the bottom of the tailings near the contact zone with native soil. These bluish gray tailings generally contain moisture as a result of their finer-grained texture. Particle size analyses performed on selected TP-2 tailings samples are presented in Table 3-3. These results indicate that the tailings are predominantly sandy silts that may have clay concentrations up to 25%.

The native soils below the tailings pile generally consist of dark brown to black silty loam with variable gravel, rock and moisture content. Shovel pit TP2-H4 contained abundant pink quartzite rock in the native soil zone. Iron oxide is generally minor in the native soil below TP-2 tailings. The native soil was saturated in backhoe test pit TP2-7 at approximately 4 feet below surface. Minor wood and metal debris are contained in the tailings pile.

Representative samples for chemical analyses were collected from vertical channel samples taken from test pit walls, from grab samples collected from test pit excavation stockpiles or from hand auger soil cores. Individual samples were collected based on similar geologic characteristics. Eleven tailings samples and three representative composite tailings samples were collected from the TP-2 tailings pile for XRF screening. In addition, four native soil samples and one composite sample were collected from below the tailings near the contact zone for XRF screening and laboratory analysis, respectively. The TP-2 XRF concentration ranges for the principal elements of interest are as follows: Ag (no detection), As (59.7 - 265 ppm), Cd (no detection - 144.9 ppm), Cu (87.8 - 1,240.8 ppm), Fe (7,730.3 - 33,386 ppm), Hg (no detection - 96.1 ppm), Mn (192.7 - 13,010.8 ppm), Mo (9.2 - 486.3 ppm), Pb (175.7 - 5,700.9 ppm), and Zn (728.4 - 3,638.3 ppm). Laboratory analytical data for the three



Olympus Technical Services, Inc.	MONTANA DEQ/MINE WASTE CLEANUP BUREAU BALD BUTTE MILLSITE AND MINES LEWIS & CLARK COUNTY, MONTANA	TAILINGS PILE TP-2 AND WASTE ROCK PILE WR-1 MAP	FIGURE 3-3

DESIGN: | DRAWN: KSR | CHECKED: CRS | APPROVED: | DATE: 12/2003 | JOB NO: A1371 | SCALE: AS SHOWN | FILENAME: A1432BButte.dwg composite samples are summarized in Table 3-4. The tailings pH is slightly acidic to slightly alkaline ranging from 6.3 to 7.4 standard units (SU). The following are the mean concentration and enrichment relative to the background mean concentrations for each element:

TP-2 Tailings Mean Element Concentrations Compared to Background (quantitative laboratory results)

All Results in mg/kg

Ag	As	Ba	Cd	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Zn	T CN
15.7	194	103	14.3	14.3	831	14,466.7	8.57	839	8.0	1,963.3	18.7	2,346.7	8.88
6.3x	*4.8x*	*0.5x*	*>17.2x*	*1.4x*	*29.4x*	*0.9x*	*>17.1x*	*1.1x*	*0.9x*	*44.3x*	*>7.5x*	*10.1x*	

Notes: Analytes Cd, Hg and Sb were analyzed but not detected in background samples;
½ detection limit used for statistics
Total cyanide was not analyzed in background soil

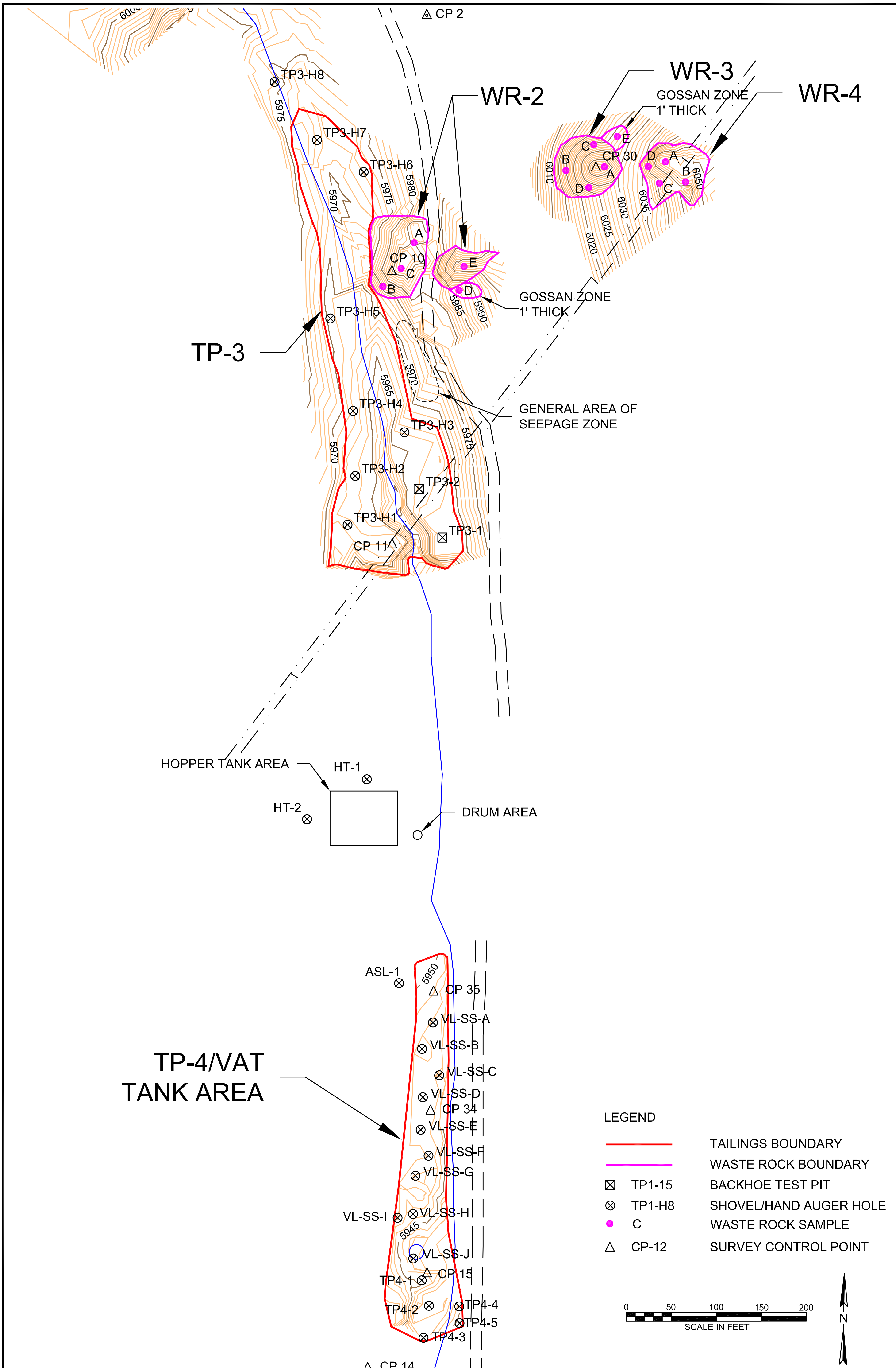
The laboratory quantitative analyses on representative composite samples generally corroborate the XRF screening results with the exception of Ag which was not detected via XRF. Analytes with an average concentration greater than three times the average background soil concentration are Ag, As, Cd, Cu, Hg, Pb, Sb, and Zn. Although total cyanide was not compared to average background soil because the parameter was not analyzed in these soils, the tailings mean concentration of 8.88 mg/Kg and a maximum concentration of 24 mg/Kg are elevated.

A single composite sample collected from the native soil below the tailings pile was analyzed for the same suite of parameters as the tailings. The results indicate that As, Cd, Cu, Pb and Zn are significantly elevated in the native soils relative to background soil concentrations. The estimated total cyanide concentration of 1.4 mg/Kg also indicates some impact to the underlying native soils. These data suggest that the metals and total cyanide are mobilizing from the tailings into the subgrade native soils.

3.2.1.3 Tailings Pile TP-3 Volume, Geology and Chemistry

Tailings pile TP-3 is located in the NE¼ Section 16, Township 11 North and Range 6 West, Montana Principal Meridian (Figure 1-1 and 1-2). The TP-3 tailings pile is located immediately downstream from the tailings pile TP-2 dam and its breached dam is near where an overhead power line crosses Dog Creek. Figure 3-4 presents the topography and location of backhoe test pits and shovel/hand auger holes used in the assessment of tailings pile TP-3. Dog Creek flows through the central portion of the tailings pile. The area is generally well vegetated with sedge grasses and some cattails. A boggy area is present on the eastside of the tailings pile immediately downstream of waste rock pile WR-2. This boggy area appears to be associated with a natural spring or a seep zone. It is not clear as to the origin of the water, but some field evidence suggests that there may be possibly two collapsed former adits associated with the WR-2, WR-3 and WR-4 waste rock piles. If there are former underground workings, they could be a source of seepage water.

The TP-3 tailings volume was estimated using the detailed topographic survey of the tailings surface and the test hole data. The volume estimate method is detailed in the Bald Butte Millsite and Devon/Sterling and Albion Mines site characterization report (DEQ-



Olympus Technical Services, Inc.	MONTANA DEQ/MINE WASTE CLEANUP BUREAU BALD BUTTE MILLSITE AND MINES LEWIS & CLARK COUNTY, MONTANA	TAILINGS PILES TP-3 AND TP-4, VAT LEACH/HOPPER TANK AND WASTE ROCK PILES WR-2, WR-3 & WR-4 MAP	FIGURE 3-4

DESIGN:	DRAWN: KSR	CHECKED: CRS	APPROVED:	DATE: 12/2003	JOB NO: A1371	SCALE: AS SHOWN	FILENAME: A1432BButte.dwg

MWCB/Olympus, 2004). The TP-3 tailings area covers approximately 1.0 acre and contains an estimated volume of 3,270 cubic yards. The average thickness is 2.0 feet and the maximum tailings thickness measured in the test holes was 9.0 feet.

The TP-3 tailings pile consists of predominantly tan to light brown, fine-grained sand with lesser dark green to gray sandy silt in the near surface portion of the pile. Bluish gray to greenish gray, clayey silt tailings slimes form the basal zone of the tailings pile. Some red-orange to reddish brown oxidation is evident generally as lenses or pockets within the tailings. Particle size analyses for selected tailings intervals are summarized in Table 3-3. The laboratory analyses for representative samples of tan/gray sand and bluish gray to dark green clayey silt tailings from TP-3 indicate that these tailings are silty sand and sandy silt with 20% clay, respectively. The native soils beneath the tailings piles are composed of dark brown silty loam with gravel. The finer-grained tailings at depth and the native soils are generally moist to saturated. The shallow ground water where observed in TP-3 test holes appears to be 3 to 4 feet below the ground surface. Minor wood debris is present in the tailings pile area. Some rusted, steel 55-gallon drums are present near the upstream extension of tailings pile TP-3, just downstream of the TP-2 dam. At least one of the drums is filled with a white, crystalline chemical. The chemical is very soluble in water and has a strong alkaline pH of 13. The chemical is probably sodium hydroxide, a caustic chemical used to control pH in the cyanide leach process.

Representative samples for chemical analyses were collected from vertical channel samples taken from test pit walls, from grab samples collected from test pit excavation stockpiles or grab samples from hand auger soil cores. Individual samples were collected based on similar geologic characteristics. Five tailings samples and two representative composite tailings samples were collected from the TP-3 tailings for XRF screening. In addition, one native soil sample was collected for XRF screening. The TP-3 XRF concentration ranges for the principal elements of interest are as follows: Ag (no detection), As (64.1 - 150.5 ppm), Cd (no detection), Cu (293.1 - 757 ppm), Fe (13,355.8 - 22,208.5 ppm), Hg (no detection - 56.1 ppm), Mn (1,857.3 - 5,531.3 ppm), Mo (66.1 - 174.9 ppm), Pb (1,521.2 - 2,337.8 ppm), Sb (no detection - 113.5 ppm) and Zn (1,528.3 - 2,467.8 ppm).

Laboratory analytical data for the two composite samples collected from the TP-3 tailings are summarized in Table 3-4. The tailings pH is slightly acidic to neutral ranging from 6.3 to 7.0 standard units (SU). The following are the mean concentration and enrichment relative to the background mean concentrations for each element.

TP-3 Tailings Mean Element Concentrations Compared to Background (quantitative laboratory results)

All Results in mg/kg

Ag	As	Ba	Cd	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Zn	T CN
10	194	138	14	12	684	15,550	4.85	5,055	10	2,230	55	2,240	0.455
>4.0x	*4.8x*	*0.7x*	*>16.9x*	*1.1x*	*24.2x*	*0.9x*	*>9.7x*	*6.4x*	*1.1x*	*50.3x*	>22.0x	*9.7x*	

Notes: Analytes Ag, Cd, Hg and Sb were analyzed but not detected in background samples; ½ detection limit used for statistics
Total cyanide was not analyzed in background soil

The mean concentrations from the laboratory quantitative analyses on representative composite samples generally corroborate the XRF screening concentration results with the exception of Ag and Cd which were not detected via XRF. The analytes with an average concentration greater than or equal to three times the average background soil concentration include: Ag, As, Cd, Cu, Hg, Mn, Pb, Sb and Zn. Although total cyanide was not compared to average background soil because the parameter was not analyzed in these soils, the tailings mean concentration of 0.455 mg/Kg and an estimated maximum concentration of 0.64 mg/Kg are slightly elevated.

A single sample collected from the native soils in TP3-1 below the tailings pile was analyzed via XRF method. No elements of interest were detected greater than 3 times the background soil mean concentration in the subgrade soils. These data suggest that metal mobility from the tailings into the underlying native soil is significantly less than that determined for tailings piles TP-1 and TP-2.

3.2.1.4 Tailings Pile TP-4 and Vat Leach/Hopper Tank Area Volume, Geology and Chemistry

Tailings pile TP-4 and the Vat Leach/Hopper Tank areas are located in the SE¼ Section 16, Township 11 North and Range 6 West, Montana Principal Meridian (Figure 1-1 and 1-2). The actual TP-4 area is a small, breached earthen dam immediately downstream from a historical vat leach operation area. The vat leach area contains abundant wood and metal debris (nails, piping, metal tank bands), much of which was related to the wooden vats. A minor amount of brick and some tree logs also are contained in Vat Leach area. A single, small wooden vat remains near the downstream extent of the vat leach area. The remnants of a small wooden structure occur immediately upstream of the former vat tank area and just downstream from the hopper tank area. This former building was most likely a small assay lab because some cupels, glass and brick debris are contained in a small tailings pile adjacent to the building debris. The tailings, cupels and glass are probably sample rejects and debris from the analytical lab. The brick may be debris from a former small furnace in the lab. A small concrete foundation is located in the former building area and this may have been associated with a furnace. In both the vat leach and hopper tank areas there are piles of flattened, rusted steel drums that most likely contained process chemicals including cyanide. The drums are similar to drums observed in the TP-1 area that had discernable, painted cyanide labels.

The hopper tank area is relatively small and contains a wooden frame structure, metal debris and the location of a former 35 feet diameter tailings mix tank with the remains of a 3 feet high wooden trestle and some smaller tank structures. The mix tank area contains some tailings, most of which appears to be tank bottom residual. Some metal piping and brick debris are also present near the main wooden frame structure. Another approximately 35 feet diameter area contains numerous flattened, rusted steel drums and lids. These drums most likely contained chemicals used in the cyanide vat leach operation. There is a white chemical in the hopper tank area as a residual in a wooden tank and in scattered piles around the immediate site area. This material appears to be lime (white, chalky, strong effervescence with hydrochloric acid, strong alkaline paste pH and 22% calcium in XRF analysis) which was probably used as a pH control chemical in the cyanide vat leach process.

The tailings contained in the vat leach and hopper tank areas are most likely related to vat overflow and tank bottom residuals. The minimal volume of tailings located upstream of the TP-4 dam suggests that the dam may have been used as a fresh water holding source that was impacted by vat overflow discharges or the bulk of the tailings that may have been contained were washed downstream when the earthen dam was breached. The area is sparsely vegetated with grasses, willows and some small conifers.

A detailed topographic map of the TP-4 tailings and Vat Leach/Hopper Tank area is presented on Figure 3-4. The hopper tank and assay lab area are relatively small areas that were not surveyed in detail, but were mapped with GPS coordinates. The TP-4 and Vat Leach/Hopper Tank area tailings volume was estimated using the detailed topographic survey of the TP-4 and Vat Leach tailings surface and the shovel/hand auger hole data. The volume estimate method is detailed in the Bald Butte Millsite and Devon/Sterling and Albion Mines site characterization report (DEQ-MWCB/Olympus, 2004). The estimated volume of the tailings is 420 cubic yards. The tailings plan area is 0.51 acre and the average tailings depth and maximum thickness are 0.5 feet and 2.0 feet, respectively.

The tailings contained in the Hopper Tank and assay lab areas were estimated from field measurements and shovel pit excavations. The dimensions of tailings associated with the Hopper Tank are a 35 feet diameter circular area containing an average 2.5 feet thickness and the assay lab reject pile are 16 feet long by 4 feet wide by an average 0.3 feet thickness. The estimated volume of tailings contained in the Hopper Tank and assay lab reject pile are 89 cubic yards and 0.7 cubic yards, respectively. The total estimated volume of tailings for the TP-4, Vat Leach/Hopper Tank and assay lab areas is 510 cubic yards.

The tailings in the TP-4 and Vat Leach/Hopper Tank area are variably-colored silty clays with lesser silty sand. The more sand-rich tailings are generally tan to light gray or chalky white while the silty clays are light green. The tailings commonly have thin layers or bands <½ inch thick of finer-grained silty clays or clayey silts. Wood debris and/or timbers related to the tank bottom or wooden foundation are common at the base of the tailings. Two small areas of bluish gray silty sand to fine-grained sand are located on the slope near the downstream end of the vat leach tank area near the drum disposal site. XRF analytical results (sample VL-ss-I) indicate that this material, which is probably tailings, contains significantly higher copper, zinc and calcium and lower iron concentrations than the other tailings in the Vat Leach Tank area. Some green, oxidized copper staining was observed in the Vat Leach Tank area. Particle size analyses for selected tailings intervals are summarized in Table 3-3. The laboratory analysis for the representative sample of tan, fine-grained sand from TP-4 indicates that these tailings are silty sand with only 2.5% clay.

Where native soils were intersected, they consisted of variably colored brown to tan to orange silty clays and rock generally less than one inch diameter. The presence of iron oxide as orange coloration suggests that tailings and/or vat leach solutions may have impacted the native soils beneath the vat leach tank area. Dog Creek flows along the eastern toe of the vat leach area. Based on the water elevation in Dog Creek at the toe of the Vat Leach Tank area and the moisture content of the deeper shovel pits, ground water is estimated to be very shallow, probably less than 3 feet below ground surface in the Vat Leach Tank area.

Representative samples were collected from vertical channel samples taken from shovel pit walls or from grab samples collected from the shovel pit excavation stockpiles or hand auger borings. Individual samples were collected based on similar geologic characteristics. Thirteen tailings samples and two representative composite tailings samples were collected from the TP-4 and Vat Leach/Hopper Tank areas for XRF screening. The XRF concentration ranges for the principal elements of interest are as follows: Ag (no detection), As (no detection - 293.2 ppm), Cd (no detection), Cu (263.5 - 2,675.5 ppm), Fe (7,316.8 - 22,204.2 ppm), Hg (no detection), Mn (242.7 - 1,432.6 ppm), Mo (19.2 - 291.2 ppm), Pb (451.3 - 4,804.8 ppm), Sb (no detection - 71 ppm), and Zn (957.1 - 4,424.3 ppm).

Laboratory analytical data for the two composite samples collected from the TP-4 and Vat Leach/Hopper Tank tailings area are summarized in Table 3-4. The tailings pH is slightly acidic ranging from 6.6 to 6.7 standard units (SU). The following are the mean concentration and enrichment relative to the background mean concentrations for each element.

TP-4 and Vat Leach/Hopper Tank Tailings Mean Element Concentrations Compared to Background (quantitative laboratory results)

All Results in mg/kg

Ag	As	Ba	Cd	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Zn	T CN
	149	158.5	22	18	925	20,550	6.1	743	7.3	1,653	15.5	3,355	2.11
	3.7x	*0.8x*	*>26.5x*	*1.7x*	*32.7x*	*1.2x*	*>12.2x*	*0.9x*	*0.8x*	*37.3x*	*>6.2x*	*14.5x*	

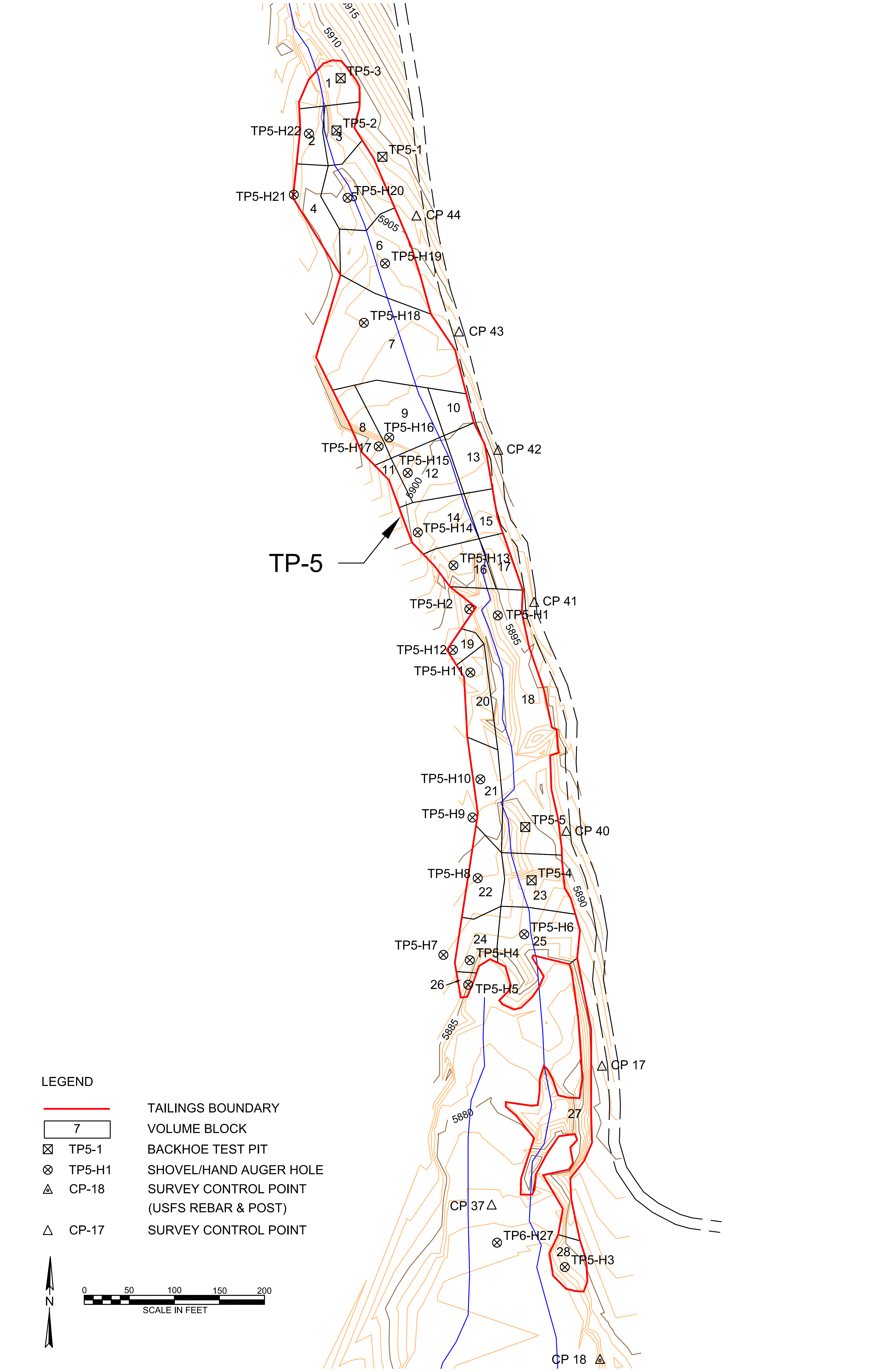
Notes: Analytes Cd, Hg and Sb were analyzed but not detected in background samples;
½ detection limit used for statistics
Total cyanide was not analyzed in background soil
Ag was not detected in the composite samples

The mean concentrations from the laboratory quantitative analyses on representative composite samples generally corroborate the XRF screening mean concentration results with the exception of Cd and Hg which were not detected via XRF. The analytes with an average concentration greater than or equal to three times the average background soil concentration include: As, Cd, Cu, Hg, Pb, Sb and Zn. Although total cyanide was not compared to average background soil because the parameter was not analyzed in these soils, the tailings mean concentration of 2.11 mg/Kg and a maximum concentration of 4.2 mg/Kg are moderately elevated.

3.2.1.5 TP-5 Tailings Volume, Geology and Chemistry

The tailings pile TP-5 is located in the SE¼ Section 16 and NE¼ Section 21, Township 11 North and Range 6 West, Montana Principal Meridian (Figure 1-1 and 1-2). These tailings are believed to be the Upper Penobscot tailings that were generated from the Penobscot mine/mill operation (Hyder, 1934). The tailings area is complex in that much of the tailings are located in a former placer operation area, the tailings appear to have been excavated and reprocessed and there are fluvially-deposited tailings from upstream tailings releases. The downstream extent of the TP-5 tailings area has been determined to be upstream of the intersection of American Gulch with Dog Creek. The area is generally moderately well vegetated with sedge grasses, willows and some small conifer trees. In the lower tailings area, the topography is commonly hummocky as a result of small placer tailings piles containing predominantly rock and gravel. Field evidence indicates that Dog Creek was diverted into small channels on the west side of the tailings area during previous operations probably related to tailings reprocessing. In some small areas, the Dog Creek channel is braided and appears to follow zones of mill tailings around placer tailings piles.

A detailed survey of the TP-5 tailings area was completed and the topographic map is shown on Figure 3-5. The TP-5 area tailings volume was estimated using the detailed topographic survey of the TP-5 tailings surface and the backhoe test pit and shovel/auger hole data. The volume estimate method is detailed in the Bald Butte Millsite and Devon/Sterling and Albion Mines site characterization report (DEQ-MWCB/Olympus, 2004). Five backhoe test pits and 22 shovel/hand auger holes were excavated to evaluate the TP-5 tailings area. The estimated



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MONTANA DEQ/MINE WASTE CLEANUP BUREAU
BALD BUTTE MILLSITE AND MINES
LEWIS & CLARK COUNTY, MONTANA

TAILINGS PILE TP-5 MAP

FIGURE 3-5

DESIGN:	DRAWN: KSR	CHECKED: CRS	APPROVED:	DATE: 12/2003	JOB NO: A1371	SCALE: AS SHOWN	FILENAME: A1432BButte.dwg

tailings volume of TP-5 is 2,400 to 4,700 cubic yards. The range of volume estimates were calculated using two different methods: Eagle Point surface model (2,400 cubic yards) and block area times thickness (4,700 cubic yards). Two methods were employed for the volume calculation because of the highly variable tailings thickness and the spacing of test locations. The tailings plan area is 2.62 acres and the range of average tailings depth and the maximum thickness are 0.6 to 1.1 feet and 2.7 feet, respectively.

The tailings in the TP-5 area are predominantly tan to light brown, fine to medium-grained sand with variable orange brown FeOx. Lesser clayey silt to silty clay tailings lenses occur in the sands. Some dark brown native soil layers may be present in the tailings indicating periods of fluvial tailings deposition probably related to upstream releases during stormwater/snowmelt runoff events. As described above, the tailings thickness is highly variable as a result of secondary processes that resulted in excavation and erosion. Particle size analyses for selected tailings intervals are summarized in Table 3-3. The laboratory analyses for representative samples of light brown, fine-grained sand and bluish gray sand tailings from TP-5 indicate that these tailings are silty sand and sandy silt with 10% clay, respectively.

The native soils beneath the tailings are generally dark brown silty loams with abundant gravel and lesser rock. The contact between the tailings and native soil is generally sharp and FeOx is commonly absent in the native soil near the contact zone. Some minor charcoal fragments were observed in the tailings. The tailings area contains very minor wood and metal debris.

Representative samples were collected from vertical channel samples taken from backhoe or shovel pit walls or from grab samples collected from the backhoe/shovel pit excavation stockpiles. Individual samples were collected based on similar geologic characteristics. Thirteen tailings samples and three representative composite tailings samples were collected from the TP-5 tailings for qualitative to semi-quantitative XRF screening. The TP-5 tailings XRF concentration range results for the principal elements of interest are as follows: Ag (no detection), As (no detection - 280.2 ppm), Cd (no detection), Cr (no detection), Cu (97.8 - 1,337.4), Fe (6,062 - 23,416 ppm), Hg (no detection - 57.5 ppm), Mn (152.5 - 25,713.7 ppm), Ni (no detection), Mo (9.8 - 161.7 ppm), Pb (547.4 - 6,000.4 ppm), Sb (no detection - 98.9 ppm), and Zn (241.6 - 4,344.1 ppm).

Laboratory analytical data for the three composite samples collected from the TP-5 tailings are summarized in Table 3-4. The tailings pH is alkaline ranging from 6.3 to 6.6 standard units (SU). The following are the mean concentration and enrichment relative to the background mean concentrations for each element.

TP-5 Tailings Mean Element Concentrations Compared to Background (quantitative laboratory results)

All Results in mg/kg

Ag	As	Ba	Cd	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Zn	T CN
15	251	117	15.3	8.7	910.7	15,100	8.4	5,878.3		2,573.3	67.3	2,338.3	0.70
>6.0x	*6.2x*	*0.6x*	*>18.4x*	*0.8x*	*32.2x*	*0.9x*	*>16.8x*	*7.4x*		*58.1x*	*>26.9x*	*10.1x*	

Notes: Analytes Ag, Cd, Hg and Sb were analyzed but not detected in background samples;
½ detection limit used for statistics
Total cyanide was not analyzed in background soil
Ni was not detected in the composite samples

The mean concentrations from the laboratory quantitative analyses on representative composite samples generally corroborate the XRF screening mean concentration results with the exception of Ag, Cd, and Cr which were not detected via XRF. The analytes with an average concentration greater than or equal to three times the average background soil concentration include: Ag, As, Cd, Cu, Hg, Mn, Pb, Sb and Zn. Although total cyanide was not compared to average background soil because the parameter was not analyzed in these soils, the tailings mean concentration of 0.7 mg/Kg and a maximum concentration of 1.6 mg/Kg are slightly elevated.

Two representative native soil samples below the tailings were collected for XRF screening only. The XRF results indicate that As, Cu, Pb, Sb and Zn are elevated greater than 3 times background soil concentrations in all samples analyzed. Manganese was elevated significantly above background soil concentrations in half of the samples of native soils below the tailings. These data indicate that the native soils beneath the tailings in the TP-5 area have been impacted by the tailings or tailings from upstream releases.

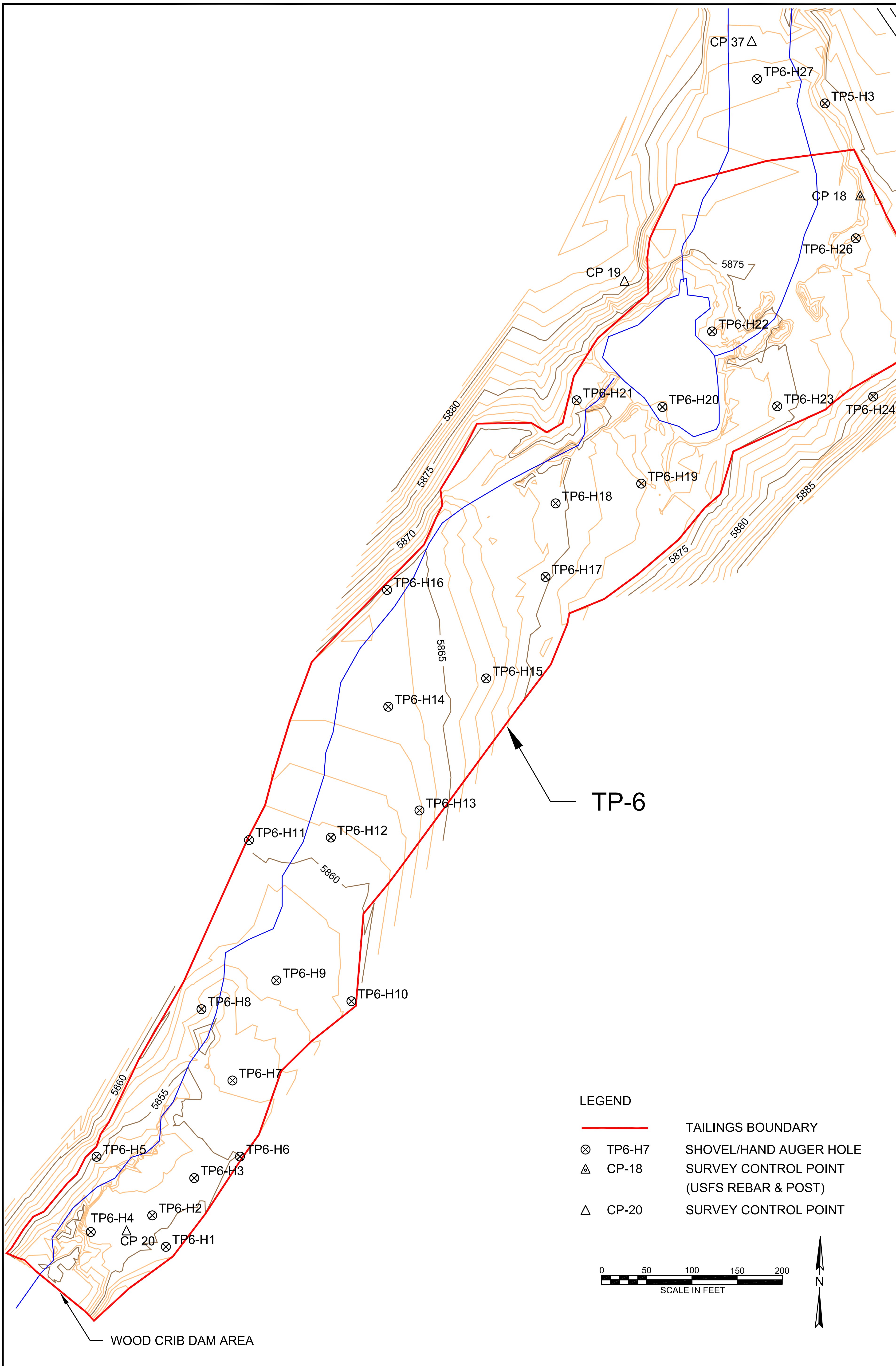
3.2.1.6 TP-6 Tailings Volume, Geology and Chemistry

The TP-6 tailings pile is located in the NE¼ Section 21, Township 11 North and Range 6 West, Montana Principal Meridian (Figure 1-1 and 1-2). These tailings were referenced as the Lower Penobscot tailings in Hyder (1934). The northern end of the tailings pile starts at the intersection of American Gulch with the Dog Creek drainage. Most of the tailings area is a wetlands-type of environment with sedge grasses and willows as the predominant vegetation pattern. The presence of wetlands is most likely the result of the accumulation of fine-grained tailings sediments that increase the water holding capacity. The lower end of TP-6 is defined by a breached wooden crib dam that was constructed across the Dog Creek drainage. There does not appear to be an under-drain structure to divert upstream water beneath the tailing pile. Hyder's (1934) report summarizing his evaluation of the Penobscot tailings for reprocessing indicated that scattered tailings of doubtful continuity and depth occur below the crib dam. He believed these tailings to be reprocessed tailings from a “former plant located on the knoll beside the dam”. There is no obvious field evidence that a tailings reprocessing plant was located in this area.

Due to the relatively shallow ground water and boggy nature of this tailings facility, all test holes were done using a hand shovel and/or hand auger. These field methods were effective because of the limited thickness of the tailings.

A detailed survey of the TP-6 tailings area was completed and the topographic map is shown on Figure 3-6. The tailings volume was estimated using the detailed topographic survey of the tailings surface and the test pit data. The volume estimate method is detailed in the Bald Butte Millsite and Devon/Sterling and Albion Mines site characterization report (DEQ-MWCB/Olympus, 2004). Twenty eight shovel/hand auger holes were used to evaluate the TP-6 tailings area. The estimated volume of the tailings is 11,170 cubic yards. The tailings plan area is 6.64 acres and the average tailings depth is 1.0 feet. The maximum tailings thickness intersected in the test pits was 5.3 feet.

The tailings contained in the TP-6 area consist predominantly of tan, fine-grained sand with variable orange brown FeOx in the upper levels and bluish gray, fine-grained sand to light greenish gray clayey silt to silty clay at depth. The latter units are generally very moist to saturated. Particle size analyses for selected tailings intervals are summarized in Table 3-3.



Olympus Technical Services, Inc.	MONTANA DEQ/MINE WASTE CLEANUP BUREAU BALD BUTTE MILLSITE AND MINES LEWIS & CLARK COUNTY, MONTANA	TAILINGS PILE TP-6 MAP	FIGURE 3-6

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The laboratory analyses for representative samples of tan sand, bluish gray sand, and gray clayey silt tailings from TP-6 indicate that these tailings are silty sand, silty sand with increased silt concentration, and silty clay, respectively. The native soils beneath the tailings are predominantly dark brown silty loam with abundant organic matter and variable gravel and rock. The native soils generally do not contain visible FeOx, but when present, the concentration is minor. Native soils beneath the TP-6 tailings are generally saturated.

A beaver pond is located at the upper end of TP-6 and based on the new tree cuttings on the dam, the pond is actively being used by beavers. Downstream of the pond, numerous small shallow channels have been created by the beaver as pathways into willow food sources. In most cases, these channels are excavated in the upper tailings layer. The water is commonly reddish to orange FeOx colored and FeOx flocculants are present in the shallow channel bottom. These observations indicate that the tailings are being oxidized and are likely contributing to acid rock drainage (ARD) conditions.

A concentration of white to beige, fine-grained tailings sand occurs in the southeast corner of the tailings area adjacent to the crib dam. The area is generally devoid of vegetation and appears to get frequent use by cattle. It is possible that these exposed tailings could be TP-6 tailings that were reprocessed and discharged from a small, local plant as indicated by Hyder (1934).

Representative samples were collected from vertical channel samples taken from shovel test pit walls or from hand auger core samples. Individual samples were collected based on similar geologic characteristics. Fourteen tailings samples and four representative composite tailings samples were collected from the TP-6 tailings for XRF screening. The TP-6 tailings XRF concentration ranges for the principal elements of interest are as follows: Ag (no detection), As (no detection - 332.2 ppm), Cd (no detection), Cr (no detection), Cu (196.2 - 730.3 ppm), Fe (6,038.9 - 20,011.9 ppm), Hg (no detection), Mn (155.2 - 2,949.8 ppm), Ni (no detection), Mo (48 - 283.2 ppm), Pb (28.5 - 2,622.5 ppm), Sb (no detection - 55.1 ppm), and Zn (99.5 - 3,476.1 ppm).

The laboratory data are summarized in Table 3-4. The TP-6 tailings pH is acidic ranging from 5.0 to 6.4 standard units (SU). The following are the mean concentration and enrichment relative to the background mean concentrations for each element.

TP-6 Tailings Mean Element Concentrations Compared to Background (quantitative laboratory results)

All Results in mg/kg

Ag	As	Ba	Cd	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Zn	T CN
7.6	109.8	167.8	13.9	9	570	10,652.5	3.5	1253.3	6.4	1,094.3	22.6	1,967	
>3.0x	*2.7x*	*0.8x*	*>16.7x*	*0.9x*	*20.1x*	*0.6x*	*>7.0x*	*1.6x*	*0.7x*	*24.7x*	*>9.0x*	*8.5x*	

Notes: Analytes Ag, Cd, Hg and Sb were analyzed but not detected in background samples; ½ detection limit used for statistics
Total cyanide was not analyzed in background soil or detected in the tailings composite samples

The analytes with an average concentration greater than or equal to three times the average background soil concentration include: Ag, Cd, Cu, Hg, Pb, Sb and Zn. Total cyanide was not detected in the tailings composite samples. One representative native soil sample below the tailings was collected for XRF screening only. The XRF results indicate that Cu, Mn, Pb, Sb and Zn are elevated greater than 3 times background soil concentrations. These data indicate that the native soils beneath the tailings in the TP-6 area have been impacted by the tailings or tailings from upstream releases.

3.2.2 Bald Butte Millsite Waste Rock Piles Volume, Geology and Chemistry

The Bald Butte Millsite waste rock piles are located in the NE¼ Section 16, Township 11 North, Range 6 West, Montana Principal Meridian (Figure 1-1 and 1-2). Waste rock pile WR-1 is located to the northeast of tailings pile TP-2 on the east side of the access road. Waste rock piles WR-2, WR-3, and WR-4 are located northeast of tailings pile TP-3. Waste rock pile WR-1 was generated by a partially collapsed shaft that is fenced with barbed wire in poor condition. Waste rock piles WR-2, WR-3 and WR-4 were probably generated from at least one collapsed adit and a backfilled shaft near WR-4 that was probably filled when the power line corridor was established. The waste rock piles, with the exception of the east end of WR-2, are devoid of vegetation. Some grass and pine trees are located along the crest line of the eastern lobe of WR-2.

Some wood and metal debris are present in the area of the waste rock piles. The major areas of debris are located in the areas of WR-1 and WR-4. These include the fenced collapsed shaft and remains of a cabin on WR-1 and the remains of a wooden ramp probably used to load ore for haulage to the mill and an old boiler that are located near WR-4.

Topographic surveys were completed on the four waste rock piles (WR-1 through WR-4) in the Bald Butte Millsite project area (Figures 3-3 and 3-4). The survey data were used to calculate volume estimates for the waste rock piles. The volume estimate method is detailed in the Bald Butte Millsite and Devon/Sterling and Albion Mines site characterization report (DEQ-MWCB/Olympus, 2004). Waste rock pile WR-1 is located just northeast of tailings pile TP-2 area (Figure 3-3). The estimated volume of WR-1 is 850 cubic yards. The plan area of WR-1 is 0.26 acres and the average and maximum waste rock depths are 2.0 feet and 8.0 feet, respectively.

Waste rock pile WR-2 is located to the northeast of tailings pile TP-3 (Figure 3-4). The waste rock pile is divided into the east and west lobes by the access road that passes through the pile. The total estimated volume of WR-2 is 826 cubic yards. The total plan area of WR-2 is 0.18 acres and the average and maximum waste rock depths are 3.0 feet and 9.0 feet, respectively.

Waste rock pile WR-3 is located to the northeast of WR-2 (Figure 3-4). The waste rock pile is a steep cone-shaped pile with a thin zone of gossan-like material that probably is residual stockpiled ore at a former loading ramp. The estimated volume of WR-3 is 848 cubic yards. The plan area of WR-3 is 0.10 acres and the average and maximum waste rock depths are 5.05 feet and 16.0 feet, respectively.

Waste rock pile WR-4 is located to the southeast of WR-3 and beneath an overhead power line (Figure 3-4). The estimated volume of WR-4 is 350 cubic yards. The plan area of WR-4 is 0.09 acres and the average and maximum waste rock depths are 2.4 and 9.0 feet, respectively.

The Bald Butte Millsite waste rock piles are relatively small structures. The piles appear to have been generated from underground mine operations that were limited in extent. The predominant rock type contained in the Bald Butte Millsite waste rock piles is the Empire shale. Where the Empire shale is metamorphosed as a result of intense contact metamorphism or weak regional metamorphism it is a hornfels or meta-argillite. Meta-limestone is a minor component of the piles. The waste rock pile gradations are very heterogeneous and consist of clay up to boulder-size rocks.

The Empire shale is a gray to dark gray, very fine grained rock that commonly contains white veinlets of quartz ± carbonate. Iron oxide is highly variable and when present occurs on fracture planes and/or in quartz veinlets. Occasional vugs containing quartz ± carbonate crystals were observed.

Oxidation of waste rock pile WR-1 appears to be minor based on the surface characteristics. Test pits indicate that approximately one foot below the surface, waste rock pile WR-1 is intensely oxidized. Oxidation of the pile at depth has resulted in very abundant yellow brown FeOx alteration of the waste rock.

Waste rock piles WR-2, WR-3 and WR-4 have similar geology where the predominant rock type is a gray to bluish gray to black, very fine grained, banded meta-argillite. White quartz ± carbonate veinlets are variable as is FeOx. The intensity of oxidation at depth is more variable and generally less than waste rock pile WR-1. Near waste rock piles WR-3 and the western lobe of WR-2 are thin zones of FeOx-rich gossan. These appear to be the remnants of former ore stockpiles. The red brown gossan forms a thin veneer, generally less than one foot thick, near these waste rock piles. This material is most likely mineralized rock generated from larger quartz/carbonate veins and/or fracture/fault zones.

The toe area of the western lobe of waste rock pile WR-2 is in direct contact with Dog Creek. Any stormwater or snowmelt runoff from this pile will discharge waste rock sediment directly into Dog Creek.

Representative samples were collected from shovel pits excavated into the waste rock piles. Individual samples were collected based on similar geologic characteristics. Eighteen waste rock pile samples and seven representative composite waste rock samples were collected from the Bald Butte Millsite waste rock areas for XRF screening. The waste rock XRF concentration ranges for the principal elements of interest are as follows: Ag (no detection), As (189.5 - 20,148.6 ppm), Cd (no detection), Cr (no detection), Cu (no detection - 1,521.8 ppm), Fe (21,720 - 214,946 ppm), Hg (no detection), Mn (548.9 - 12,698.7 ppm), Mo (no detection - 43.5 ppm), Pb (68.1 - 60,313.1 ppm), Sb (no detection - 475.3 ppm), and Zn (359.5 - 72,671 ppm).

Laboratory analytical data for the seven composite samples collected from the Bald Butte Millsite waste rock piles are summarized in Table 3-5. The waste rock pH is slightly acidic to alkaline ranging from 6.2 to 8.1 standard units (SU). The following are the mean concentration and enrichment relative to the background mean concentrations for each element.

Bald Butte Millsite Waste Rock Mean Element Concentrations Compared to Background (quantitative laboratory results)

All Results in mg/kg

Ag	As	Ba	Cd	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Zn	T CN
53.4	7,734.3	95.1	86.4	21.9	555.9	104,557.1	a	5,477.3	26.7	27,357.4	94.6	18,092.7	b
>21.4x	*190x*	*0.5x*	*>104x*	*2.1x*	*19.6x*	*6.3x*		*6.9x*	*2.9x*	*617.6x*	*>37.8x*	*78x*	

Notes: a - Analyte Hg detected in only one waste rock sample at 1.3 mg/Kg
b - Analyte total cyanide was not analyzed in waste rock samples

Table 3-5. Laboratory Chemistry Results for Waste Rock

Sample ID	pH (SU)	Ag (mg/Kg)	As (mg/Kg)	Ba (mg/Kg)	Cd (mg/Kg)	Cr (mg/Kg)	Cu (mg/Kg)	Fe (mg/Kg)	Hg (mg/Kg)	Mn (mg/Kg)	Ni (mg/Kg)	Pb (mg/Kg)	Sb (mg/Kg)	Zn (mg/Kg)
Bald Butte Millsite														
25-179-WR1-1	6.2	54	20100	190	118	15	1580	158000	<1	2810	11	37000	66	14000
25-179-WR1-2	8.1	<5	290	35	2	13	72	15500	<1	451	9	292	<5	399
25-179-WR2-1	7.7	78	6600	72	109	27	544	120000	1.3	5730	32	39200	178	21100
25-179-WR2-2	7.6	8	1550	110	23	35	168	41800	<1	3640	42	3460	20	6140
25-179-WR3-1	7.7	128	13400	85	133	32	802	206000	<1	12800	52	60700	210	31600
25-179-WR3-2	7.8	14	1800	94	27	16	151	51600	<1	3430	22	5250	33	7410
25-179-WR4-1	7.7	89	10400	80	193	15	574	139000	<1	9480	19	45600	153	46000
Maximum	8.1	128	20100	190	193	35	1580	206000	1.3	12800	52	60700	210	46000
Minimum	6.2	<5	290	35	2	13	72	15500	<1	451	9	292	<5	399
Mean	7.54	53.4	7734.3	95.1	86.4	21.9	555.9	104557.1		5477.3	26.7	27357.4	94.6	18092.7
No. of Samples	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Devon/Sterling and Albion Mines														
25-179-WR1A-1	7.0	<5	418	85	5	19	976	33700	<1	2800	26	317	200	694
25-179-WR1A-2	6.9	23	167	143	31	14	1250	40400	<1	1360	10	2540	39	4810
25-179-WR4A-1	6.9	30	179	161	38	14	1650	43600	<1	1270	10	2800	41	5630
25-179-WR2A-1	4.6	9	71	186	7	17	854	37500	<1	963	10	760	9	1650
25-179-WR2A-2	5.4	7	319	158	9	19	772	47800	<1	2020	14	988	22	1370
25-179-WR3A-1	5.0	11	157	73	11	26	494	20300	<1	818	10	1550	21	1130
Maximum	7.0	30	418	186	38	26	1650	47800	<1	2800	26	2800	200	5630
Minimum	4.6	<5	71	73	5	14	494	20300	<1	818	10	317	9	694
Mean	6.0	13.8	218.5	134.3	16.8	18.2	999.3	37216.7		1538.5	13.3	1492.5	55.3	2547.3
No. of Samples	6	6	6	6	6	6	6	6	6	6	6	6	6	6

LEGEND

25-179-WR1-1 is a composite of WR1-A, B and D (strong - v. strong FeOx)
25-179-WR1-2 is a split of WR1-C (v. minor FeOx)
25-179-WR2-1 is a composite of WR2-A, C and D (abund FeOx)
25-179-WR2-2 is a composite of WR2-B and E (minor FeOx)
25-179-WR3-1 is a composite of WR3-A and WR3-E (v abund FeOx samples)
25-179-WR3-2 is a composite of WR3-B, C and D (minor- mod FeOx samples)
25-179-WR4-1 is a composite of WR4-A, B, C and D

25-179-WR1A-1 is a composite of WR1A-B and WR1A-C (strong FeOx)
25-179-WR1A-2 is a composite of WR1A-D, E and F (v. minor to minor FeOx)
25-179-WR4A-1 is a duplicate of 25-179-WR1A-2
25-179-WR2A-1 is a composite of WR2A-A and WR2A-B (strong FeOx)
25-179-WR2A-2 is a composite of WR2A-D and WR2A-E (minor FeOx)
25-179-WR3A-1 is a composite of WR3A-A, B and C

Note: Statistics - one half the lower detection limit is used where below detection limit samples are included in the mean calculation

The mean concentrations from the laboratory quantitative analyses on representative composite samples generally corroborate the XRF screening results with the exception of Ag, Cd, and Cr which were not detected via XRF. The significantly elevated concentrations of multi-elements suggest that at least some of the Bald Butte Millsite waste rock may be low grade, polymetallic vein ore. The analytes with an average concentration greater than or equal to three times the average background soil concentration are Ag, As, Cd, Cu, Fe, Mn, Pb, Sb and Zn.

3.2.3 Devon/Sterling and Albion Mines Waste Rock Piles Volume, Geology and Chemistry

The Devon/Sterling and Albion Mines are located in an unnamed, southwest-flowing tributary of Dog Creek. (Figure 1-1 and 1-2). The mine areas contain three waste rock piles (WR1A through WR3A), one partially collapsed, discharging adit near the northeast end of waste rock pile WR1A and a second collapsed adit located immediately to the southeast of waste rock pile WR2A. Three small wooden buildings are located near waste rock pile WR2A and some wood and metal debris are present in the area of all of the piles.

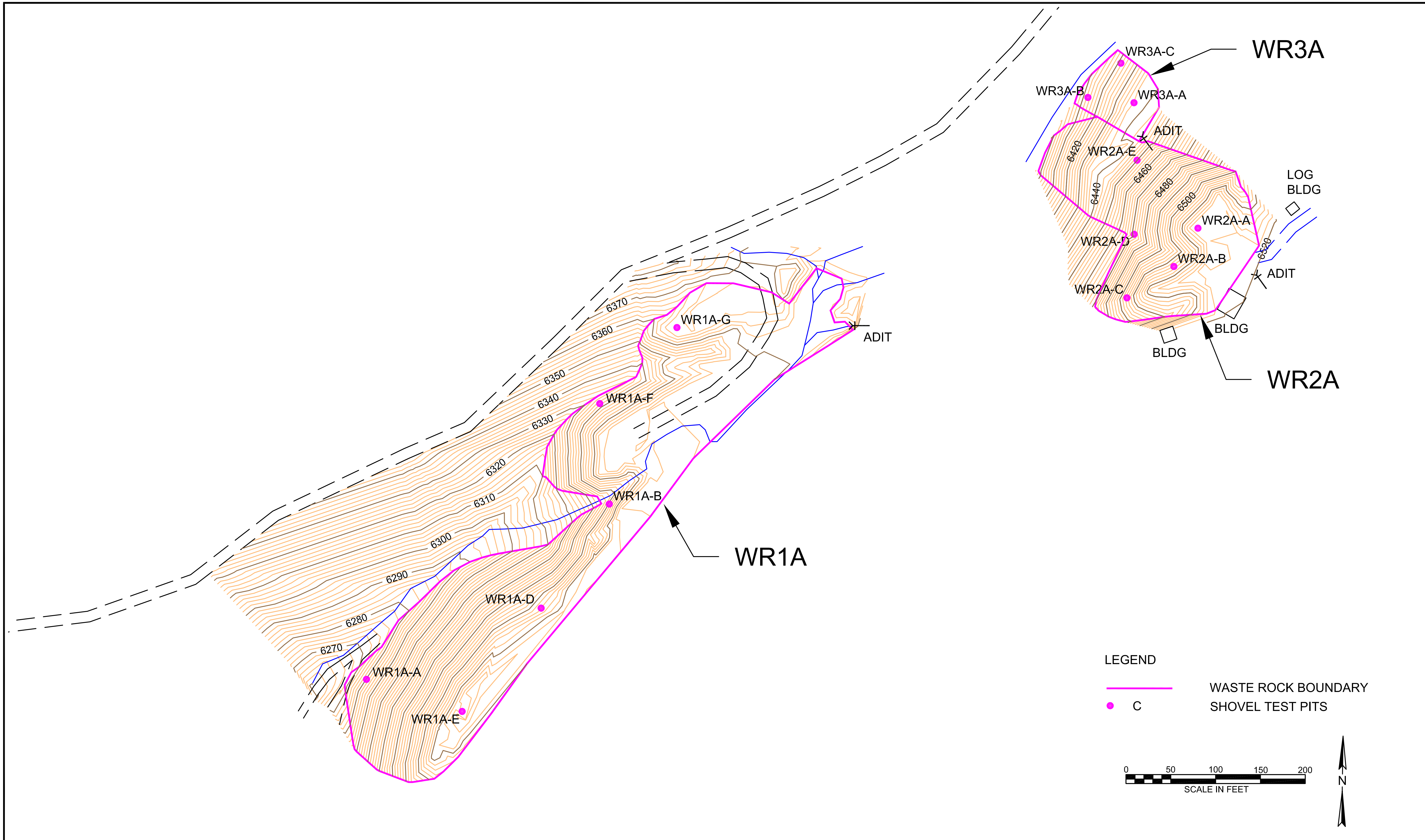
Most of the Devon/Sterling and Albion Mines waste rock piles are located on the southeast side of the unnamed tributary and were deposited at the angle of repose on steep topography. The northeast extent of waste rock pile WR1A fills in much of the narrow canyon bottom. The unnamed tributary is a perennial stream that flows adjacent to the toes of waste rock piles WR2A and WR3A and flows through a portion of waste rock pile WR1A. The groundwater from the mine adit discharges via a small tributary into the unnamed stream. It was difficult to get a good instrument flow measurement for the water discharging from the adit. The flow was estimated at ±25 gallon per minute (gpm) on September 22, 2003.

Waste rock pile WR3A is a small pile immediately adjacent to the toe area of waste rock pile WR2A. WR3A was identified as a separate pile based principally on the geology of the pile. In contrast to the other Devon/Sterling and Albion Mines waste rock piles, WR3A contains predominantly feldspar porphyry with very minor Empire shale/hornfels rock.

Topographic surveys were completed on the three waste rock piles (WR1A through WR3A) in the Devon/Sterling and Albion Mines project area (Figure 3-7). The survey data were used to calculate volume estimates for the waste rock piles. The volume estimate method is detailed in the Bald Butte Millsite and Devon/Sterling and Albion Mines site characterization report (DEQ-MWCB/Olympus, 2004). Waste rock pile WR-1 is located approximately 1,100 feet upstream on the unnamed tributary from the intersection of the unnamed tributary and Dog Creek. The estimated volume of WR1A is 21,900 cubic yards. The plan area of WR1A is 2.0 acres and the average and maximum waste rock depths are 6.8 feet and 25 feet, respectively.

Waste rock pile WR2A is located approximately 300 feet upstream along the unnamed tributary from the northeast end of WR1A (Figure 3-7). The total estimated volume of WR-2A is 10,660 cubic yards. The total plan area of WR2A is 0.78 acre and the average and maximum waste rock depths are 8.5 feet and 26 feet, respectively.

Waste rock pile WR3A is located immediately to the north along the toe area of WR2A (Figure 3-7). The estimated volume of WR3A is 380 cubic yards. The plan area of WR3A is 0.13 acre and the average and maximum waste rock depths are 1.8 feet and 6.0 feet, respectively.



NO.	REVISION DESCRIPTION	BY	DATE	DESIGN:	DRAWN: KSR	CHECKED: CRS
				APPROVED:	DATE: 12/2003	JOB NO: A1371
				SCALE: AS SHOWN	FILENAME: A1432BButte.dwg	

MONTANA DEQ/MINE WASTE CLEANUP BUREAU
BALD BUTTE MILLSITE AND MINES
LEWIS & CLARK COUNTY, MONTANA

Olympus Technical Services, Inc.

WASTE ROCK PILES
WR1A, WR2A AND WR3A MAP

FIGURE
3-7

As is typical of most mine waste rock piles, the waste rock piles are very heterogeneous ranging from clay-size fraction up to boulder-sized rocks. In general, the coarser-fraction materials are located more toward the toe areas of the pile as a result of end dumping and gravity segregation of the waste rock. In cases where the waste rock pile face slopes are steep, there can be increased finer-grained fractions accumulating toward the toe areas due to sediment transport from water runoff.

The geology of waste rock piles WR1A and WR2A are generally very similar. The predominant rock type is the Empire shale/hornfels with minor feldspar porphyry. Outcrops of this rock type occur on the slope above and within a portion of waste rock pile WR1A. The Empire shale/hornfels is a black to dark gray with lesser light greenish gray, very fine grained rock that commonly contains white quartz ± carbonate veins. The veins are generally thin (<½ inch thick) and may form a stockwork where veining is intense. Some brecciation was observed and alteration is predominantly argillic with lesser chloritization. The piles are variably oxidized with FeOx ranging from minor to very intense. In the more intensely oxidized zones of the piles, yellow brown to reddish orange FeOx is prevalent.

A light gray to chalky white feldspar porphyry is the dominant rock type contained in the waste rock pile WR3A. Variable orange brown to red brown FeOx occurs on fracture surfaces. Noticeable cubic pseudomorphs of FeOx after pyrite and primary pyritic cubes were observed in the more intense FeOx samples of feldspar porphyry. Waste rock pile WR3A contains more gravel-sized fraction and lesser finer-grained material than WR2A.

Representative samples were collected from shovel pits excavated into the waste rock piles. Individual samples were collected based on similar geologic characteristics. Fourteen waste rock samples and six representative composite samples were collected from waste rock piles WR1A, WR2A, and WR3A for XRF screening. The Devon/Sterling and Albion Mines waste rock XRF concentration range results for the principal elements of interest are as follows: Ag (no detection), As (no detection - 510.9 ppm), Cd (no detection), Cu (154.6 - 1,614.6 ppm), Fe (13,457.4 - 45,989 ppm), Mn (253.7 - 3,274 ppm), Mo (no detection - 305 ppm), Pb (no detection - 2,936.8 ppm), Sb (no detection - 225.2 ppm), and Zn (321.1 - 8,399.2 ppm). Mercury was detected in only one sample at a concentration of 120 ppm.

Laboratory analytical data for the five composite samples collected from the Devon/Sterling and Albion Mines waste rock piles are summarized in Table 3-5. The waste rock pH is moderately acidic to neutral ranging from 4.6 to 7.0 S.U. The mean concentrations and the mean concentrations relative to background mean concentrations for analytes are as follows:

Devon/Sterling and Albion Mines Waste Rock Mean Element Concentrations Compared to Background (quantitative laboratory results)

All Results in mg/kg

Ag	As	Ba	Cd	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Zn	CN
13.8	218.5	134.3	16.8	18.2	999.3	37,216.7	a	1,538.5	13.3	1,492.5	55.3	2,547.3	b
>5.5x	*5.4x*	*0.7x*	*>20.2x*	*1.7x*	*35.3x*	*2.2x*		*1.9x*	*1.5x*	*33.7x*	*>22.1x*	*11.0x*	

Notes: a - Analyte Hg was not detected in waste rock samples
b - Analyte total cyanide was not analyzed in waste rock samples

The mean concentrations from the laboratory quantitative analyses on representative composite samples generally corroborate the XRF screening concentration results with the exception of Ag and Cd which were not detected in the XRF method. The analytes with an average concentration greater than or equal to three times the average background soil concentration include: Ag, As, Cd, Cu, Pb, Sb and Zn. With the exception of Cu and Ba, the Devon/Sterling and Albion Mines waste rock piles generally have significantly less mean metal/metalloid concentrations than the Bald Butte Millsite waste rock piles.

3.2.4 Mill Tailings and Waste Rock Acid-Base Accounting Results

The mill tailings in the Dog Creek drainage area generally show some oxidation especially in the upper zones of the tailings. This is evidenced by orange brown to red brown FeOx in the tailings. All of the tailings samples analyzed generally have paste pH's that are slightly acidic to near neutral. The TP-6 tailings have the most acidic paste pH with 5.0 standard units. The tailings, with the exception of TP-6, generally do not show much field evidence of acid rock drainage (ARD) problems in Dog Creek, i.e., low pH, high concentrations of metals, and iron hydroxide precipitates in surface waters in the area of the tailings.

In Hyder's (1934) evaluation of the Bald Butte Millsite and Penobscot tailings piles, he described the tailings as being "strongly alkaline with lime". The paste pH data collected during the recent site characterization, approximately 70 years later, indicate that the tailings are slightly acidic to near neutral pH. This suggests that the tailings are producing some acid over time. The Bald Butte mineral deposits are polymetallic vein systems that contain pyrite, chalcopyrite, galena and sphalerite along with precious metals. Fortunately, the total sulfur concentrations in the mill tailings are generally very low and this has limited the ARD potential of these tailings. Much of the sulfur was probably removed in the mill flotation operation concentrate.

The modified Sobek method was used to evaluate the acid generating potential of the mill tailings present in the Dog Creek drainage. A total of eighteen composite samples were collected for ABA analyses at Northern Analytical Laboratories, Inc. The acid-base accounting laboratory analytical results are summarized in Table 3-6. The ABA data indicate that the total sulfur concentrations in the mill tailings are low ranging from <0.05% to 0.22%. All of the composite samples show positive net neutralization potential (NNP) ranging from +3.1 to +63 tons per 1000 tons $CaCO_3$ (t/1000t $CaCO_3$). With the exception of two composite tailings samples from TP-1, all of the NNP's are less than +20. Most references suggest that the static test (ABA) can reliably predict ARD risk when carbonates are more abundant than sulfides (NNP greater than +20 t/1000t $CaCO_3$) or when sulfides are dominant (NNP less than -20 t/1000t $CaCO_3$). When mine/mill waste materials fall between these criteria, the potential ARD is unknown. This is common at mine/mill sites where carbonates are low and for these conditions, one usually has to rely on kinetic humidity cell test (ASTM 1998) to assess ARD risk where static tests are uncertain. Kinetic tests are usually utilized to assess new operations that will be generating mine/mill wastes and is not very cost effective for historical facilities that have been in existence for over 100 years. After such a long period of exposure to the elements in the natural environment, these tailings have been subject to the rigors of a natural field test for ARD. A basic field examination of the tailings and surface waters flowing in or near these tailings provide valuable information as to the ARD risks. The tailings do show variable oxidation especially in the upper more sand-rich layers and the recent paste pH data indicate that the tailings are slightly acidic to near neutral with exception of TP-6 that had the most acidic pH at 5.0 standard units. As described earlier, these tailings do show some limited development of ARD conditions.

Table 3-6. Acid-Base Accounting Results For Mill Tailings, Vat Leach Tailings and Waste Rock

Sample ID	Total Sulfur (%)	Pyritic Sulfur (%) HNO_3 Ext. S	Sulfate Sulfur (%) HCL Ext. S	Hot H_2O Ext. S (%)	Residual Sulfur (%)	Acid Gen Potential *	Neutraliz Potential *	Acid/Base Potential *	Lime Requirement	SMP Buffer pH	SMP Lime Requirement	NAG pH
Bald Butte Millsite												
25-179-TP1-1	0.22	0.2	<0.1	<0.1	<0.1	5	68	63	6	7.4	0	
25-179-TP1-2	0.19	0.1	<0.1	<0.1	<0.1	5	30	25	6	7.5	0	
25-179-TP1-3	<0.05	<0.05	<0.05	<0.05	<0.05	0	3.1	3.1	0	7.5	0	6.86
25-179-TP1-4	<0.05	<0.05	<0.05	<0.05	<0.05	0	8.5	8.5	0	8.5	0	
25-179-TP2-1	<0.05	<0.05	<0.05	<0.05	<0.05	0	6.3	6.3	0	7.4	0	6.74
25-179-TP2-2	<0.05	<0.05	<0.05	<0.05	<0.05	0	5.6	5.6	0	7.1	0	
25-179-TP2-3	<0.05	<0.05	<0.05	<0.05	<0.05	0	8.1	8.1	0	8.1	0	6.71
25-179-TP3-1	<0.05	<0.05	<0.05	<0.05	<0.05	0	10.2	10.2	0	7.1	0	
25-179-TP3-2	<0.05	<0.05	<0.05	<0.05	<0.05	0	14.8	14.8	0	7.3	0	
25-179-TP4-1	<0.05	<0.05	<0.05	<0.05	<0.05	0	6.1	6.1	0	7.5	0	
25-179-TP5-1	<0.05	<0.05	<0.05	<0.05	<0.05	0	9.4	9.4	0	7.2	0	7.14
25-179-TP5-2	<0.05	<0.05	<0.05	<0.05	<0.05	0	7.6	7.6	0	7.1	0	
25-179-TP5-3	<0.05	<0.05	<0.05	<0.05	<0.05	0	4.4	4.4	0	7.4	0	
25-179-TP6-1	<0.05	<0.05	<0.05	<0.05	<0.05	0	5.8	5.8	0	7.3	0	5.94
25-179-TP6-2	<0.05	<0.05	<0.05	<0.05	<0.05	0	10.0	10.0	0	7.2	0	
25-179-TP6-3	<0.05	<0.05	<0.05	<0.05	<0.05	0	1.1	1.1	15.6	5.2	12.5	
25-179-TP7-1	<0.05	<0.05	<0.05	<0.05	<0.05	0	6.2	6.2	0	7.3	0	
25-179-VL-1	0.16	0.1	<0.1	<0.1	<0.1	5	12	7	6	7.3	0	
25-179-WR1-1	<0.05	<0.05	<0.05	<0.05	<0.05	0	23.5	23.5	7.4	5.9	5.9	
25-179-WR1-2	<0.05	<0.05	<0.05	<0.05	<0.05	0	379	379	0	7.6	0	
25-179-WR2-1	0.61	0.1	<0.1	<0.1	0.5	19	102	83	24	7.5	0	
25-179-WR2-2	<0.05	<0.05	<0.05	<0.05	<0.05	0	179	179	0	7.4	0	
25-179-WR3-1	1.12	0.5	<0.1	0.1	0.5	31	56	25	39	7.4	0	
25-179-WR3-2	0.10	0.1	<0.1	<0.1	<0.1	4	196	192	5	7.4	0	
25-179-WR4-1	0.56	0.5	<0.1	<0.1	<0.1	14	69	55	18	7.4	0	
Native Soil Beneath Tailings												
25-179-TP1-5	<0.05	<0.05	<0.05	<0.05	<0.05	0	13.7	13.7	6.6	6.2	5.3	
25-179-TP2-4	<0.05	<0.05	<0.05	<0.05	<0.05	0	12.9	12.9	2.2	6.7	1.8	
Devon/Sterling and Albion Mines												
25-179-WR1A-1	<0.05	<0.05	<0.05	<0.05	<0.05	0	30	30	0	7.4	0	7.01
25-179-WR1A-2	<0.05	<0.05	<0.05	<0.05	<0.05	0	33	33	0	7.4	0	6.99
25-179-WR4A-1	<0.05	<0.05	<0.05	<0.05	<0.05	0	33	33	0	7.4	0	6.75
25-179-WR2A-1	<0.05	<0.05	<0.05	<0.05	<0.05	0	3.8	3.8	2.2	6.7	1.8	4.63
25-179-WR2A-2	<0.05	<0.05	<0.05	<0.05	<0.05	0	7.7	7.7	0	7.0	0	6.16
25-179-WR3A-1	<0.05	<0.05	<0.05	<0.05	<0.05	0	5.2	5.2	3.9	6.5	3.1	3.54

* Tons of $CaCO_3$ equivalent per 1000 tons of material

LEGEND

See Table 3-4 and Table 3-5 for sample descriptions

The XRF qualitative to semi-quantitative results for calcium can provide some additional insight into the inherent neutralization potential of the mill tailings. These data indicate that the calcium and calculated $CaCO_3$ concentrations are quite variable in the tailings. Calcium ranges from 0.33% to 5.3% and calculated $CaCO_3$ concentrations range from 0.8% to 13.2% in the mill tailings. The extremely anomalous XRF calcium results for unknown sample VL-ss-I was not incorporated into the mill tailings range data. This sample was an unknown which appears to be lime-treated, bluish gray tailings slimes in the Vat Leach Tank area.

A simple, cost effective method that has been shown to be an effective test for determining ARD risk of samples with indeterminate static test results is the Net Acid Generation (NAG) pH test (Miller, et al., 1997). This NAG method was used to further evaluate the acid generating potential of six selected composite samples from the mill tailings. The results of the NAG testing are summarized in Table 3-6. The NAG pH results ranged from 5.94 to 7.14 standard units. A NAG pH of less than 4.0 S.U. for a mine/mill waste sample with an indeterminate static ABA is generally considered acid generating.

The Bald Butte Millsite waste rock paste pH data indicate that most of the waste rock is slightly alkaline with the exception of WR-1 which is slightly acidic (6.2 S.U.). This waste rock pile exhibited the most intense oxidation at depth of the four piles. Seven representative composite waste rock samples were analyzed by the modified Sobek method for acid-base accounting. The laboratory analytical results are summarized in Table 3-6. The ABA data indicate that the total sulfur concentrations in the waste rock range from <0.05% to 1.12%. The composite samples show significant positive net neutralization ranging from +23.5 t/1000t $CaCO_3$ to +379 t/1000t $CaCO_3$. These data indicate that the waste rock is probably not acid generating. The inherent neutralization potential of the waste rock is further corroborated by the XRF results for calcium that showed concentrations ranging from 0.4% to 9.4%. These data indicate that calcium carbonate ($CaCO_3$) concentrations may be as high as 23.5% in the waste rock.

The Devon/Sterling and Albion Mines waste rock paste pH data indicate that most of the waste rock is moderately acidic to neutral. The intensity of oxidation is variable in the waste rock piles and ranges from minor to strong. The presence of moderate acid pH conditions suggest that oxidation is causing some acid generation in the piles. Six representative composite waste rock samples were analyzed by the modified Sobek method for acid-base accounting. The laboratory analytical results are summarized in Table 3-6. The ABA data indicate that the total sulfur concentrations are low with all samples reporting <0.05%. Low total sulfur concentrations limit the potential for acid generation. The composite samples show positive net neutralization ranging from +3.8 t/1000t $CaCO_3$ to +33 t/1000t $CaCO_3$. Although positive NNP results were obtained for all composite samples, one half of the samples had positive NNP less than +8 t/1000t $CaCO_3$. To further evaluate the ARD potential of the Devon/Sterling and Albion Mines waste rock, the composite samples were tested using the NAG method. The results of the NAG testing are summarized in Table 3-6. The NAG pH results ranged from 3.54 S.U. to 6.99 S.U. A NAG pH of less than 4.0 S.U. for a mine/mill waste sample with an indeterminate static ABA is generally considered acid generating. The composite sample from waste rock pile WR3A was below the critical pH of 4.0 S.U. indicating that WR3A is potentially acid generating. This is interesting in that waste rock pile WR3A is predominantly feldspar porphyry. Cubes of pyrite and iron oxide cubic pseudomorphs after pyrite were observed in fractures contained within the porphyry. These observations indicate that this igneous rock currently contains and has had former pyrite mineralization. Oxidation of pyrite is the most likely source of the acid in the NAG pH result.

The ABA and NAG pH results indicate that a portion of the Devon/Sterling and Albion Mines waste rock is acid generating. There is some inherent neutralization potential of the waste rock and this is further corroborated by the XRF results for calcium that showed concentrations ranging from 0.39% to 2.6%. These data indicate that calcium carbonate ($CaCO_3$) concentrations may be as high as 6.5% in the waste rock.

3.2.5 Mill Tailings and Waste Rock TCLP Results

Because mill tailings and mine waste rock are derived from the beneficiation and extraction of ores, according to the Bevill Amendment they are exempt from federal hazardous waste regulations under the Resource Conservation and Recovery Act (RCRA). However, to evaluate the RCRA metals (Ag, As, Ba, Cd, Cr, Hg, Pb and Se) leaching potential of these wastes, selected samples of the Bald Butte Millsite and Devon/Sterling and Albion Mines waste sources were analyzed using the Toxicity Characteristic Leaching Procedure (TCLP).

Based on the laboratory analytical results for the Bald Butte Millsite tailings, splits of composite samples were selected for metals TCLP analysis. For the eight RCRA metals, chemistry results for mill tailings show that cadmium, lead and mercury are the elements of most concern in the mill tailings contained in the Dog Creek drainage. Based on the laboratory analytical results, five composite mill tailings samples elevated in these elements were selected for TCLP analysis at Northern Analytical Laboratories, Inc. in Billings, Montana. The tailings TCLP laboratory analytical results are summarized in Table 3-7. The results indicate that lead exceeded the regulatory levels for metal toxicity under the RCRA rules for hazardous waste classification in all but one of the mill tailings samples. Barium and cadmium were detected in most of the leachates, but at concentrations well within the regulatory limit. Mercury was detected at the lower detection limit in half of the mill tailings samples analyzed, but concentrations were also well within the regulatory limit.

Splits of Bald Butte Millsite waste rock composite samples 25-179-WR2-1 and 25-179-WR3-1 were also collected for RCRA metals TCLP analysis. The waste rock TCLP laboratory analytical results are summarized in Table 3-7. The results indicate that lead concentrations (8.6 mg/L to 13.2 mg/L) exceeded the regulatory level of 5 mg/L for metal toxicity under the RCRA rules for hazardous waste classification. Barium and cadmium were also detected in the leachates, but the concentrations were within the regulatory limits of 100 mg/L and 1 mg/L, respectively. Barium concentrations ranged from 0.5 mg/L to 1.5 mg/L and cadmium ranged from <0.1 mg/L to 0.4 mg/L.

Splits of Devon/Sterling and Albion Mines waste rock composite samples 25-179-WR1A-2, 25-179-WR2A-2 and 25-179-WR3A-1 were collected for RCRA metals TCLP analysis. The waste rock TCLP laboratory analytical results are summarized in Table 3-7. The results indicate that the lead concentration (24.8 mg/L) in the waste rock pile WR1A exceeded the regulatory level of 5 mg/L for metal toxicity. The other two samples had detectable lead in the leachates, but the concentrations did not exceed the regulatory level. Barium, cadmium and mercury were also detected in some of the leachates, but the concentrations were within the regulatory limits of 100 mg/L, 1 mg/L and 0.2 mg/L, respectively.

Table 3-7. TCLP Metals for Mill Tailings and Waste Rock

Sample ID	Ag (mg/L)	As (mg/L)	Ba (mg/L)	Cd (mg/L)	Cr (mg/L)	Hg (mg/L)	Pb (mg/L)	Se (mg/L)
Tailings								
25-179-TP1-2	<0.2	<0.5	0.8	0.4	<0.1	0.001	**23.2**	<0.5
25-179-TP2-3	<0.2	<0.5	0.7	0.1	<0.1	<0.001	**17.1**	<0.5
25-179-TP3-2	<0.2	<0.5	1.5	0.2	<0.1	<0.001	**17.8**	<0.5
25-179-TP5-1	<0.2	<0.5	0.5	<0.1	<0.1	0.001	0.5	<0.5
25-179-TP6-2	<0.2	<0.5	1.0	0.2	<0.1	<0.001	**25.0**	<0.5
Waste Rock								
25-179-WR2-1	<0.2	<0.5	0.4	0.7	<0.1	<0.001	**8.6**	<0.5
25-179-WR3-1	<0.2	<0.5	0.9	0.6	<0.1	<0.001	**13.2**	<0.5
25-179-WR1A-2	<0.2	<0.5	0.5	0.3	<0.1	0.001	**24.8**	<0.5
25-179-WR2A-2	<0.2	<0.5	0.3	<0.1	<0.1	<0.001	0.8	<0.5
25-179-WR3A-1	<0.2	<0.5	0.5	0.2	<0.1	<0.001	2.1	<0.5
Regulatory Level	5	5	100	1	5	0.2	5	1

LEGEND

25-179-TP2-3 is a composite of TP2-4-2.1-3.1 and TP2-7-0.5-3.0; blue-gray slimes
25-179-TP3-2 is a composite of TP3-1-4.7-7.5 and TP3-H2-0.5-3.8; bluish gry and drk grn clayey silt tailings
25-179-TP5-1 is a composite of TP5-2-0.1-0.7, TP5-H5-0-0.5 and TP5-H10-0.1-1.6; lt brn fn gr sand tailings w/minor FeOx
25-179-TP6-2 is a composite TP6-H8-0.5-1.8, TP6-H12-0.3-4.4, TP6-H14-0.2-3.0 and TP6-H18-0.1-3.4; bluish gry sand tailings
25-179-WR1A-2 is a composite of WR1A-D, E and F (v. minor to minor FeOx)
25-179-WR2A-1 is a composite of WR2A-A and WR2A-B (strong FeOx)
25-179-WR3A-1 is a composite of WR3A-A, B and C
25-179-WR2-1 is a composite of WR2-A, C and D (abund FeOx)
25-179-WR3-1 is a composite of WR3-A and WR3-E (v abund FeOx samples)

3.3 SURFACE WATER AND GROUND WATER CHARACTERIZATION

The Bald Butte Millsite and Devon/Sterling and Albion Mine sites are located in the Dog Creek drainage, a tributary to the Little Blackfoot River. The headwaters of Dog Creek are located approximately 1.4 miles upstream from the Bald Butte Millsite tailings pile TP-1 near the former Penobscot Mine area (Figure 1-1). The only perennial stream tributaries to Dog Creek in the project area are two unnamed streams (located immediately north and south of Bald Butte), Dago Gulch and American Gulch (Figure 2-3). The Devon/Sterling and Albion Mines waste rock piles are located in the unnamed stream drainage north of Bald Butte and upstream of the Bald Butte Millsite tailings piles. The Dago Gulch stream discharges into Dog Creek in the areas of tailings piles TP-1 and TP-2.

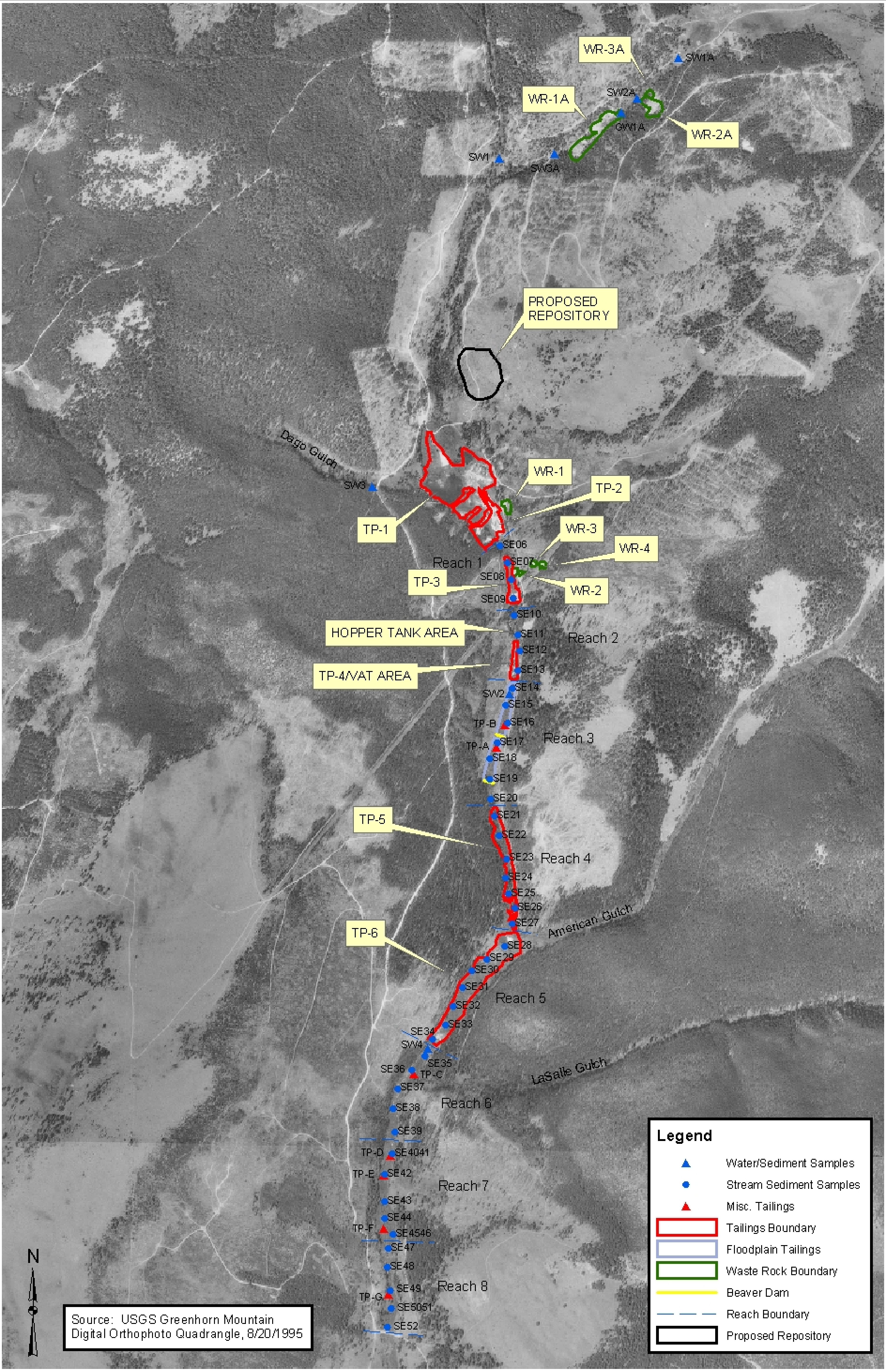
Further downstream along Dog Creek, a small tributary stream drains the south portion of Bald Butte and discharges into Dog Creek near tailings pile TP-3. American Gulch is the final downstream tributary drainage in the project area. This stream discharges into Dog Creek near the upstream end of tailings pile TP-6. LaSalle Gulch discharges into Dog Creek approximately 700 feet downstream from the wood crib dam of tailings pile TP-6.

Seven surface water samples and one duplicate water sample were collected to assess potential impacts from the mine/mill waste sources contained in the Bald Butte Millsite and Devon/Sterling and Albion Mine sites. Two of these surface water samples, 25-179-SW3 and 25-179-SW1A, were collected as surface water background samples for the two project areas, respectively. The surface water sample locations are shown on the aerial orthophotograph presented on Figure 3-8. The surface water samples were collected on September 22, 2003 according to standard protocols as described in the Field Sampling Plans for the Bald Butte Millsite and Devon/Sterling and Albion Mines (DEQ-MWCB/Olympus, 2003a and 2003b). At each sample site, stream flow was estimated and field parameters including pH, temperature, and specific conductivity were measured. Surface water samples were analyzed at Northern Analytical Laboratories, Inc. in Billings, Montana for pH, total dissolved solids, sulfate, chloride, nitrate + nitrite as N, hardness and a fourteen element suite including Ag, As, Ba, Ca, Cd, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Sb and Zn.

The laboratory analytical results are summarized in Table 3-8. The surface water chemistry results should represent low flow conditions as they were collected during the Fall season and not during a stormwater runoff event. The surface water results indicate that Ag, Cr, Cu, Hg, Ni and Sb were not detected in any of the surface water samples collected from the Devon/Sterling and Albion Mines or Bald Butte Millsite areas.

In the Devon/Sterling and Albion Mines area, surface water sample 25-179-SW1A was collected as a background sample upstream of the mine waste rock piles and adit discharge. The sample site is located near springs and close to the unnamed tributary headwater area. The former Bald Butte townsite was located in this area. Progressing downstream, surface water samples 25-179-SW2A and 25-179-SW3A were collected below waste rock piles WR2A/WR3A and WR1A, respectively.

The background surface water quality sample result indicates that the Federal secondary MCLs and Montana HHS standards for Fe (1,020 ug/L) and Mn (110 ug/L) were exceeded. The surface water quality hardness (as $CaCO_3$) for all samples collected in the Dog Creek drainage ranged from 142 mg/L to 165 mg/L. To be conservative, the hardness concentration of 100 mg/L $CaCO_3$ was used to evaluate acute and chronic freshwater aquatic life standards (ALS).



Olympus Technical Services, Inc.

0 1,000 Feet

Figure 3-8
Surface Water and Stream
Sediment Sample Locations

TABLE 3-8. Laboratory Chemistry Results For Surface Water and Adit Discharge

Total Recoverable Metals

Sample ID	Ag (ug/L)	As (ug/L)	Ba (ug/L)	Ca (mg/L)	Cd (ug/L)	Cr (ug/L)	Cu (ug/L)	Fe (ug/L)	Hg (ug/L)	Mn (ug/L)	Ni (ug/L)	Pb (ug/L)	Sb (ug/L)	Zn (ug/L)
25-179-SW1	<5	4	<100	48	<1	<10	<10	140	<0.2	40	<10	9	<5	110
25-179-SW2	<5	13	100	46	<1	<10	<10	410	<0.2	130	<10	3	<5	20
25-179-SW3	<5	7	100	35	<1	<10	<10	300	<0.2	50	<10	<2	<5	<10
25-179-SW4	<5	13	<100	37	<1	<10	<10	610	<0.2	130	<10	14	<5	10
25-179-SW5	<5	13	<100	37	<1	<10	<10	570	<0.2	120	<10	12	<5	10
25-179-SW1A	<5	5	<100	54	<1	<10	<10	1020	<0.2	110	<10	8	<5	<10
25-179-SW2A	<5	4	<100	52	<1	<10	<10	700	<0.2	90	<10	13	<5	<10
25-179-SW3A	<5	5	<100	53	4	<10	<10	30	<0.2	<5	<10	2	<5	300
25-179-GW1A	<5	4	<100	63	18	<10	80	30	<0.2	310	20	8	<5	3550
Federal MCL	-	50	2000	-	5	-	1300	300	2	50	100	15	6	5000
Montana HHS	100	18		-	5	-	1300	300	0.05	50	100	15	6	2000
Chronic ALS		150			0.27		9.3	1000	0.91		52.2	3.2		119.8
Acute ALS	4.1	340			2.1		14		1.7		469	81.6		119.8

Surface Water Wet Chemistry Results

Sample ID	pH (SU)	TDS (mg/L)	Sulfate (mg/L)	Chloride (mg/L)	Nitrate + Nitrite as N (mg/L)	Hardness as $CaCO_3$ (mg/L)
25-179-SW1	8.4	186	13	<2	0.31	145
25-179-SW2	8.2	186	19	<2	<0.05	160
25-179-SW3	8.1	157	18	<2	<0.05	157
25-179-SW4	8.3	138	15	<2	<0.05	142
25-179-SW5	8.3	145	14	<2	<0.05	142
25-179-SW1A	8.4	174	9	<2	0.26	151
25-179-SW2A	8.4	172	10	<2	0.18	150
25-179-SW3A	8.2	216	50	<2	0.11	165
25-179-GW1A	7.4	316	139	<2	0.29	227
Federal MCL	6.5-8.5	500	250	250	10	
Montana HHS						

Surface Water Field Measurements

Sample ID	pH (SU)	Temp (°C)	SC (mS)	Stream Flow (cfs)
25-179-SW1	8.10	4	0.34	0.19
25-179-SW2	7.94	8	0.23	0.14
25-179-SW3	7.96	5	0.21	0.13
25-179-SW4	8.14	8	0.19	2.50
25-179-SW5	8.14	8	0.19	2.50
25-179-SW1A	8.05	6	0.24	0.05
25-179-SW2A	8.22	4	0.22	0.15
25-179-SW3A	7.91	6	0.26	0.12
25-179-GW1A	7.45	3	0.39	0.055

LEGEND

25-179-SW1	9/22/2003	Sample collected from Dog Creek approximately 40 feet upstream of unnamed tributary draining Devon/Sterling and Albion Mine sites (UTM coord: 396524E; 5175032N)
25-179-SW2	9/22/2003	Sample collected from Dog Creek approximately 100 feet downstream of TP4 tailings dam area (UTM coord: 396594E; 5173218N)
25-179-SW3	9/22/2003	Sample collected from Dago Gulch stream approximately 60 ft. upstream of access road to Bald Butte Millsite (UTM coord: 396116E; 5173910N)
25-179-SW4	9/22/2003	Sample collected from Dog Creek approximately 100 feet downstream of TP6 tailings crib dam (UTM coord: 396340E; 5172009N)
25-179-SW5	9/22/2003	Duplicate sample of 25-179-SW4
25-179-SW1A	9/22/2003	Sample collected from Dog Creek just upstream of intersection with road accessing Bald Butte townsite area upstream of Devon/Sterling and Albion Mine sites (UTM coord: 397124E; 5175384N)
25-179-SW2A	9/22/2003	Sample collected from Dog Creek just downstream of Albion waste rock pile toe; (UTM coord: 396987E; 5175242N)
25-179-SW3A	9/22/2003	Sample collected from Dog Creek just downstream of Devon/Sterling waste rock pile WR1A; approximately 60 ft. upstream of road intersection (UTM coord: 396709E; 5175049N)
25-179-GW1A	9/22/2003	Sample collected from discharging, partially collapsed adit at the Devon/Sterling Mine; drains into Dog Creek (UTM coord: 396934E; 5175194N)

Federal MCL - Federal primary and secondary maximum contaminant level based on total recoverable metal concentration; Drinking Water Standards and Health Advisories, EPA October 1996

Montana HHS - Montana human health standard based on dissolved metal concentration; Circular WQB-7 Montana Numeric Water Quality Standards, January 2002

Chronic/Acute ALS - Chronic and acute aquatic life standards based on a hardness of 100 mg/l $CaCO_3$; Circular WQB-7 Montana Numeric Water Quality Standards, January 2002

The background sample exceeds the chronic ALS for Pb (8 ug/L) and Fe (1,000 ug/L). Relative to the background water sample, the results indicate a slight increase in Pb below waste rock piles WR2A/WR3A and increases in Cd and Zn below waste rock pile WR1A. The concentration levels for these elements were within Federal safe drinking water maximum contaminant levels (MCL's) and Montana human health standards (HHS). The surface waters in the unnamed tributary drainage exceed chronic ALS for lead (3.182 ug/L) at site SW2A immediately below WR2A/WR3A waste rock piles. Cadmium (4 ug/L) and zinc (300 ug/L) exceed both acute and chronic ALS at site SW3A below WR1A. The discharge water from a partially collapsed adit near the upstream extent of waste rock pile WR1A was sampled (25-179-GW1A) to evaluate the groundwater quality generated from the underground mine. The analytical results are summarized in Table 3-8. The mine water exceeds Federal MCLs and Montana HHS for Cd (18 ug/L) and Mn (310 ug/L), and Montana HHS for Zn (3,550 ug/l). In addition, Cd, Cu and Zn exceed acute and chronic ALS and Pb exceeds chronic ALS in the mine adit discharge water. Although the sulfate concentration of 139 mg/L in the adit discharge water was within the Federal secondary MCL, this concentration was significantly higher than the other surface water quality results.

Increased sulfate concentrations in discharge water commonly occur as a result of ARD reactions and this suggests that some oxidation of sulfur may be occurring in the underground mine. This water drains directly into the unnamed tributary and would contribute to the elevated concentrations of Cd and Zn in the downstream surface water sample SW3A. Manganese is most likely precipitating upon oxygenation of the water as a result of turbulent flow via the steep gradient through the waste rock pile. The Mn concentration in SW3A was below detection limit. The presence of black staining on the unnamed stream channel gravels downstream of the adit discharge would support this interpretation.

Surface water sample 25-179-SW1 was collected from Dog Creek upstream of the intersection of the unnamed tributary containing the Devon/Sterling and Albion Mines waste rock. This sample was designed to evaluate the surface water quality upstream of the Devon/Sterling and Albion waste rock areas and the Bald Butte Millsite tailings and waste rock piles. This site was not considered non-impacted background surface water quality because of the location of the Penobscot Mine near the headwaters of Dog Creek. Surface water sample SW3 was collected from Dago Gulch to characterize background surface water quality in the area of the Bald Butte Millsite mine/mill wastes. Two additional surface water samples were collected downstream on Dog Creek: SW2 (downstream of TP-4 and Vat Leach Tank area) and SW4 (downstream of TP-6 wood crib dam). Surface water sample SW5 was a duplicate sample collected from the SW4 site.

The Dog Creek surface water quality results are summarized in Table 3-8. The upstream surface water sample site, SW1, did not exceed any Federal MCLs or Montana HHS. Lead (9 ug/L) exceeded chronic ALS and Zn (110 ug/L) was just under the acute and chronic ALS concentration of 119.8 ug/L. These results suggest that Pb and Zn are somewhat elevated in the background surface water quality or there is some impact from upstream waste source(s). The background surface water sample, SW3, was within Federal MCL's and Montana HHS and did not exceed any acute or chronic ALS's. The only parameters that exceed Federal secondary MCLs and Montana HHS for water quality downstream along Dog Creek are Fe (410 and 610 ug/l) and Mn (130 ug/L) at sites SW2 and SW4. In addition, Pb (14 ug/L) exceeds chronic ALS at site SW4.

With the exception of the adit discharge water sampling and an assessment of groundwater depth in a potential mine/mill waste repository site, no other groundwater characterization work was planned or completed. The field sampling plan provided for three monitoring wells in a potential repository area, if they were needed to assess shallow ground water depth. Some of the backhoe test pits excavated to assess a potential repository site were able to reach shallow groundwater and provide depth information. Shallow groundwater was intersected in two of the potential repository test pits at depths of 5 feet and 7.8 feet below ground surface. With the exception of one possible well upstream on Dago Gulch, there do not appear to be any groundwater wells in the immediate project areas.

3.4 STREAM SEDIMENT CHARACTERIZATION

The details of the reconnaissance stream sediment sampling program in the Dog Creek drainage are contained in the Site Characterization Report for the Bald Butte Millsite and Devon/Sterling and Albion Mine Sites (DEQ-MWCB/Olympus, 2004). A summary of the results of this work is presented below.

Stream sediments were collected from Dog Creek and an unnamed tributary of Dog Creek in the area of and downstream from the Bald Butte Millsite and Devon/Sterling and Albion Mines waste sources. Sediments collected along with surface water in the immediate area and immediately downstream of the waste sources (referred to as on-site stream sediments) were analyzed at Northern Analytical Laboratories, Inc. using the same analytical parameters (Ag, As, Ba, Cd, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Sb, Zn, total cyanide and paste pH) as the tailings waste sources. The on-site stream sediment sample locations are presented on Figure 3-8 and the analytical results are summarized in Table 3-9.

The on-site stream sediment samples were collected from areas above and below the Devon/Sterling and Albion waste rock piles and above and below the Bald Butte Millsite tailings and waste rock piles to characterize the background stream sediment and to look at possible impacts from the waste sources. The on-site stream sediment samples were collected at the same time and in the same location as the surface water quality samples discussed in Section 3.3. Stream sediment samples SE-1 through SE-5 and SE-1A through SE-3A (Figure 3-8) were collected to evaluate background stream sediment concentrations and to characterize impacts from the Bald Butte Millsite and Devon/Sterling and Albion mine areas, respectively.

The Dog Creek stream channel upstream from the Bald Butte Millsite (i.e., upstream from tailings pile TP-1) has been impacted by years of historic mining (Hyder, 1934). This makes it difficult to determine representative upstream background concentrations. Based on the sample locations and field observations, stream sediment samples SE-1A and SE-3 have been selected as the most representative of background conditions. Sample SE-1A is located upstream from the Devon/Sterling and Albion waste rock piles and appears to be outside of the area of major historic mining impacts. The sample location is near the Continental Divide and there are no known mine sites upstream. Sample SE-3 is located on the Dago Gulch stream channel approximately 60 feet upstream of the access road to the Bald Butte Millsite. This location is on the Cold Spring placer claim. However, there is no evidence of significant mining activity in this area. This area was reportedly used to supply water to the Bald Butte mill. Although neither of these background sample locations is located on Dog Creek, they are considered more representative of background condition because of upstream mining activities on Dog Creek. Based on these factors, the background stream sediment concentration will be taken as the average concentrations of samples SE-1A and SE-3 for each analyte. The background stream sediment concentrations are shown in Table 3-9.

Table 3-9. Laboratory Chemistry Results for On-Site and Background Stream Sediments and Multiplier above Background Concentrations

Sample ID	pH (SU)	Ag (mg/Kg)	As (mg/Kg)	Ba (mg/Kg)	Cd (mg/Kg)	Cr (mg/Kg)	Cu (mg/Kg)	Fe (mg/Kg)	Pb (mg/Kg)	Hg (mg/Kg)	Mn (mg/Kg)	Ni (mg/Kg)	Sb (mg/Kg)	Zn (mg/Kg)
On-Site Stream Sediment Samples														
25-179-SE1	7.6	7	133	172	5	10	336	18100	1880	3.4	4350	6	38	1300
		2.80 x	0.57 x	0.44 x	1.00 x	0.65 x	5.33 x	0.65 x	9.15 x	6.80 x	2.87 x	0.48 x	8.94 x	2.19
25-179-SE2	7.3	2.5 *	682	342	14	11	371	27000	1030	1.7	4890	11	16	2430
		1.00 x	2.90 x	0.88 x	2.80 x	0.71 x	5.89 x	0.97 x	5.01 x	3.40 x	3.22 x	0.88 x	3.76 x	4.10
25-179-SE4	6.7	6	172	141	17	10	676	15000	882	3.7	962	7	16	2590
		2.40 x	0.73 x	0.36 x	3.40 x	0.65 x	10.73 x	0.54 x	4.29 x	7.40 x	0.63 x	0.56 x	3.76 x	4.37
25-179-SE5	6.8	5	156	133	17	10	690	15400	777	3.4	951	7	14	2530
		2.00 x	0.66 x	0.34 x	3.40 x	0.65 x	10.95 x	0.55 x	3.78 x	6.80 x	0.63 x	0.56 x	3.29 x	4.27
25-179-SE2A	7.5	8	84	214	4	18	203	23200	1030	7.0	1150	13	10	587
		3.20 x	0.36 x	0.55 x	0.80 x	1.16 x	3.22 x	0.83 x	5.01 x	14.00 x	0.76 x	1.04 x	2.35 x	0.99
25-179-SE3A	7.7	2.5 *	88	131	13	16	656	21300	699	0.5 *	1620	15	8	2620
		1.00 x	0.37 x	0.34 x	2.60 x	1.03 x	10.41 x	0.77 x	3.40 x	1.00 x	1.07 x	1.20 x	1.88 x	4.42
Background Stream Sediment Samples														
25-179-SE3	6.7	2.5 *	390	521	7	11	22	26800	44	0.5 *	2040	11	2.5 *	668
25-179-SE1A	7.4	2.5 *	80	256	3	20	104	28800	367	0.5 *	993	14	6	517
Mean Background		2.5 *	235	388.5	5	15.5	63	27800	205.5	0.5 *	1516.5	12.5	4.25 *	592.5

LEGEND

25-179-SE1	09/22/03	Sample collected from Dog Creek approximately 40 feet upstream of unnamed tributary draining Devon/Sterling and Albion Mine sites (UTM coord: 396524E; 5175032N)
25-179-SE2	09/22/03	Sample collected from Dog Creek approximately 100 feet downstream of TP4 tailings dam area (UTM coord: 396594E; 5173218N)
25-179-SE3	09/22/03	Sample collected from Dago Gulch stream approximately 60 ft. upstream of access road to Bald Butte Millsite (UTM coord: 396116E; 5173910N)
25-179-SE4	09/22/03	Sample collected from Dog Creek approximately 100 feet downstream of TP6 tailings crib dam (UTM coord: 396340E; 5172009N)
25-179-SE5	09/22/03	Duplicate sample of 25-179-SW4
25-179-SE1A	09/22/03	Sample collected from an unnamed tributary of Dog Creek just upstream of intersection with road accessing Bald Butte townsite area upstream of Devon/Sterling and Albion Mine sites (UTM coord: 397124E; 5175384N)
25-179-SE2A	09/22/03	Sample collected from an unnamed tributary to Dog Creek just downstream of Albion waste rock pile toe; (UTM coord: 396987E; 5175242N)
25-179-SE3A	09/22/03	Sample collected from an unnamed tributary to Dog Creek just downstream of Devon/Sterling waste rock pile WR1A; approximately 60 ft. upstream of road intersection (UTM coord: 396709E; 5175049N)

*One half the lower detection limit is used where below detection limit samples are included in the mean calculation

x - multiplier above mean background (x times greater than the mean)

Besides the laboratory chemistry results, Table 3-9 also presents the element concentrations relative to the stream sediment mean background. The value of three times the mean background concentration is frequently used to identify potential contaminants of concern. For sample SE-1, several elements exceed three times the mean background concentration, including Cu, Hg, Pb and Sb. Sample SE-1 was collected from Dog Creek, upstream of the unnamed tributary that drains the Devon/Sterling and Albion waste rock piles. These concentrations indicate that Dog Creek has been impacted by historic mining operations above the Bald Butte Millsite or that background concentrations are naturally high because of the mineralization that made the area conducive to mining.

Stream sediment sample SE-2 was collected below the tailings pile TP-4 dam. Element concentrations in sample SE-2 that exceed three times the mean background concentration include: Cu, Hg, Mn, Pb, Sb and Zn. Stream sediment sample SE-4 (SE-5 is a duplicate of SE-4) was collected from Dog Creek below tailings pile TP-6. Element concentrations in sample SE-4 that exceed three times the mean background concentration include Cd, Cu, Hg, Pb, Sb and Zn. Stream sediment sample SE-2A was collected from the unnamed tributary to Dog Creek just downstream from the toe of the Albion waste rock pile WR-2A. Element concentrations in sample SE-2A that exceed three times the mean background concentration include: Ag, Cu, Hg, and Pb. Stream sediment sample SE-3A was collected from the unnamed tributary to Dog Creek just downstream from the Devon/Sterling waste rock pile (WR-1A). Element concentrations in sample SE-3A that exceed three times the mean background concentration include: Cu, Pb and Zn.

Reconnaissance stream sediments were collected from Dog Creek just downstream of tailings pile TP-2 to a point where the Bald Butte Millsite access road crosses Dog Creek, a distance of approximately 1.8 miles. Hyder (1934) reported that tailings discharged from the Penobscot mill, located on the Continental Divide, were discharged into Dog Creek. Tailings were reported to have been deposited over a distance of 1.5 miles down the canyon from the Bald Butte tailings "over a long period of years in patches, and two considerable areas which are called 'Penobscot Tailings'." These areas correspond to tailings piles TP-5 and TP-6. The purpose of the reconnaissance stream sediment samples was to characterize the sediment chemistry and identify areas of other potential tailings deposition. Stream sediment samples were collected from Dog Creek at an average frequency of approximately 25 samples per stream mile or approximately every 200 lineal feet. A total of 44 stream sediment samples and three duplicates were collected for analysis. The reconnaissance stream sediment samples were analyzed at Northern Analytical Laboratories, Inc. for As, Cd, Cu, Hg, Pb, Sb, Zn, total cyanide and paste pH. Stream sediment sample locations are presented on Figure 3-8 and the analytical results are summarized in Table 3-10.

The median and maximum concentration in reconnaissance stream sediments for the parameters analyzed are as follows: As 310.5 mg/Kg (976.0 mg/Kg), Cd 13 mg/Kg (29 mg/Kg), Cu 434.5 mg/Kg (1,060 mg/Kg), Pb 902 mg/Kg, (2,830 mg/Kg), Hg 2.3 mg/Kg (14 mg/Kg), Sb 15 mg/Kg, (73 mg/Kg) and Zn 2,020 mg/Kg, (3,990 mg/Kg). Total cyanide was present above the detection limit of 0.5 mg/Kg in 32 of the 47 stream sediment samples. Using ½ of the detection limit for values below the detection limit, the concentrations of total cyanide had a median and maximum concentration of 0.6 mg/Kg and 1.8 mg/Kg, respectively. Paste pH values ranged from 5.5 to 7.5 SU, with both a mean and median of 6.9 SU. The following is a summary of the median concentration and enrichment relative to the background mean concentrations for each element.

Table 3-10. Laboratory Chemistry Results For Reconnaissance Stream Sediment Samples From Dog Creek

Sample ID	Distance (ft)	pH (SU)	As (mg/Kg)	Cd (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Hg (mg/Kg)	Sb (mg/Kg)	Zn (mg/Kg)	Total CN (mg/Kg)	Comment
25-179-SE-6	0	6.5	278	14	434	950	2	12	2070	0.68 J	Directly below TP-2
25-179-SE-7	201	7	541	7	198	898	0.5 *	6	1570	0.25 *J	
25-179-SE-8	399	6.7	306	14	468	756	1.8	8 J	2190	0.25 *J	Near toe of WR-2
25-179-SE-9	601	6.8	199	21	1060	2350	14	27	3170	0.25 *J	Near center of TP-3
25-179-SE-10	799	6.9	747	26	711	2400	1.8	18	3990	0.25 *J	
25-179-SE-11	1016	7.2	643	14	450	1250	1.1	20	2380	0.83 J	Between hopper tank and assay lab
25-179-SE-12	1196	7.2	534	10	279	900	0.5 *	18	1910	0.84 J	Upper end of vat leach area
25-179-SE-13	1416	7.2	591	12	301	1010	1.5	16	2110	0.75 J	Below vat leach area
25-179-SE-14	1624	7.2	813	17	401	1360	1.3	15	2730	1.8 J	Below TP-4
25-179-SE-15	1830	7.2	604	15	435	882	1.7	15	2410	0.68 J	
25-179-SE-16	2028	7	969	26	582	1450	2.5	22	3710	1.3 J	
25-179-SE-17	2268	7.2	543	27	711	1440	5.3	16	3920	0.76 J	
25-179-SE-18	2464	7	261	29	825	1200	3.6	15	3920	0.58 J	
25-179-SE-19	2694	6.9	336	26	809	1300	4.4	15	3640	0.25 *J	In beaver pond
25-179-SE-20	2918	7.2	236	17	596	1380	3.9	22	2460	0.83 J	Near upper end TP-5
25-179-SE-21	3107	7.4	169	10	385	829	0.5 *	15	1660	1 J	In TP-5
25-179-SE-22	3333	7.2	278	17	583	1230	2.2	22	2590	0.83 J	In TP-5
25-179-SE-23	3601	7.5	188	12	344	904	0.5 *	15	1800	1.5 J	In TP-5
25-179-SE-24	3814	7.4	322	8	276	638	0.5 *	11	1410	1.4 J	In TP-5
25-179-SE-25	3998	6.7	976	7	290	711	0.5 *	12	1340	0.59 J	
25-179-SE-26	4170	7.4	308	9	313	668	0.5 *	9	1680	0.25 *J	
25-179-SE-27	4354	6.7	548	11	426	767	1.3	13	1680	0.72 J	
25-179-SE-28	4617	6.9	187	10	299	573	2.6	8	1410	0.25 *J	Back side of beaver dam
25-179-SE-29	4864	7	319	13	364	782	3.4	10	1670	0.53 J	Small beaver pond
25-179-SE-30	5069	7.1	479	13	347	754	2.9 J	10	1880	0.52 J	Upper end of TP-6
25-179-SE-31	5291	6.7	309	16	531	1260	3.5	27	2360	0.63 J	In TP-6
25-179-SE-32	5522	6.9	641	17	587	1240	4.3	21	2520	0.25 *J	In TP-6
25-179-SE-33	5741	6.4	473	16	462	1080	3.5	19	2380	0.56 J	In TP-6
25-179-SE-34	5958	7.1	162	14	446	603	1.1	12	2170	0.5 J	At TP-6 dam
25-179-SE-35	6162	6.9	170	12	497	473	0.5 *	8	1820	0.92 J	Below TP-6 dam
25-179-SE-36	6376	7	130	7	281	369	0.5 *	6	1080	1	Between wood bridge and beaver dam
25-179-SE-37	6634	5.9	149	6	230	509	1.7	9	1000	1	Below beaver dam

Table 3-10. Laboratory Chemistry Results For Reconnaissance Stream Sediment Samples From Dog Creek

Sample ID	Distance (ft)	pH (SU)	As (mg/Kg)	Cd (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Hg (mg/Kg)	Sb (mg/Kg)	Zn (mg/Kg)	Total CN (mg/Kg)	Comment
25-179-SE-38	6863	5.5	134	7	220	425	1.2	5	910	0.25 *	Entire floodplain marshy
25-179-SE-39	7123	6.3	212	12	416	808	2.5	12	1810	0.51	
25-179-SE-40	7371	6.8	286	14	847	2830	5.5 J	73	2960	0.25 *	
25-179-SE-41	7371	6.9	269	14	798	2700	4.4	68	3100	0.25 *	Duplicate of SE-40
25-179-SE-42	7614	6.6	177	13	592	938	2.4	23 J	1970	0.25 *	
25-179-SE-43	7909	6.8	207	11	377	851	2.2	21	1730	0.58	
25-179-SE-44	8106	7.4	322	15	568	1150	3.8	18	2220	0.95	Entire floodplain marshy
25-179-SE-45	8309	6.7	546	16	486	1190	4.3	16	2380	0.6	
25-179-SE-46	8309	6.8	539	16	482	1200	4.6	15	2420	0.25 *	Duplicate of SE-45
25-179-SE-47	8476	6.9	361	13	384	1120	3.8	14	1890	0.9	
25-179-SE-48	8683	6.9	312	8	291	776	3.3	13	1390	1.3	
25-179-SE-49	8947	7	371	16	456	1200	4.1	16	2420	0.72	
25-179-SE-50	9141	6.4	188	10	326	741	2.5	14	1560	0.25 *	
25-179-SE-51	9141	6.5	166	9	288	679	2.3	11	1410	0.25 *	Duplicate of SE-50
25-179-SE-52	9355	6.4	90	12	447	757	3	16 J	1740	0.56	

*Value is one-half of detection limit where result is less than detection limit. J - estimated value

Statistics (not including duplicate samples)	pH	As	Cd	Cu	Pb	Hg	Sb	Zn	Total CN
Maximum	7.5	976.0	29.0	1060.0	2830.0	14.0	73.0	3990.0	1.8
Minimum	5.5	90.0	6.0	198.0	369.0	0.5	5.0	910.0	0.3
Mean	6.9	377.6	14.1	462.1	1038.7	2.6	16.2	2173.0	0.7
Median	6.9	310.5	13.0	434.5	902.0	2.3	15.0	2020.0	0.6
Standard Deviation	0.4	223.3	5.7	185.5	498.2	2.3	10.3	776.9	0.4
Skew	-1.3	1.1	1.1	1.2	1.9	3.1	4.0	0.9	0.9
No. Samples	44	44	44	44	44	44	44	44	44

Dog Creek Stream Sediment Median Element Concentrations Compared to Background
(quantitative laboratory results)

All Results in mg/kg

As	Cd	Cu	Hg	Pb	Sb	Zn	T CN
310.5	13	434.5	2.3	902	15	2,020	0.6[a]
1.3x	*2.6x*	*6.9x*	*>4.6x*	*4.4x*	*3.5x*	*3.4x*	*b*

Notes: [a]*Total cyanide was detected above method detection limit in 32 of the 47 samples analyzed*
½ of the detection limit used for values below detection limit
b - Total cyanide not analyzed in background samples

This comparison of stream sediment metal/metalloid concentrations to background indicates that mean arsenic concentrations are approximately equal to background and cadmium concentrations are greater than background. Copper, lead, mercury, antimony and zinc concentrations are significantly elevated relative to background. It should be noted that the background stream sediment concentration for mercury was taken as 0.5 mg/Kg (half of the detection limit) since mercury was not present above the detection limit of 1 mg/Kg in the background samples.

To evaluate the metal/metalloid concentrations in stream sediments in more detail, Dog Creek was divided into eight separate stream reaches. These reaches were selected based on a number of factors including: reach length, the number of samples per reach, waste sources within a reach and other physical features. The reaches are shown on Figure 3-8. Table 3-11 summarizes the mean, median, maximum and the ratio of stream sediment median concentration to mean background concentration for stream sediments by stream reach.

Evaluation of the trends in arsenic, cadmium, copper, lead, mercury antimony, zinc, pH and total cyanide concentrations in stream sediments show some distinctive patterns. First, with the exception of antimony and pH, peak analyte concentrations consistently occur in Reach 3. Reach 3 is defined by two large beaver dam/beaver ponds areas that have impounded a significant amount of fluvially-deposited mill tailings (Figure 3-8). Lesser or secondary peak median values also occur in Reach 7, and to a lesser extent in Reaches 2 and 4. The lowest median concentration generally occurs in Reach 6. Other low median concentrations also frequently occur in Reach 4.

The frequent occurrence of high analyte concentrations in stream sediments in Reach 3 could be explained by erosion from tailings piles TP-1 through TP-4 and Vat Leach Tank area, by the discharge of tailings from past reprocessing of the Bald Butte tailings, and by the fluvial deposition and impoundment of these tailings behind the two large beaver dams. The Reach 3 floodplain also possibly contains tailings that originated from the Penobscot Mine. Hyder (1934) described the Penobscot tailings as dark (blue or black) with more sand than the Bald Butte tailings. The tailings in Reach 3 are a gray color and are generally sandy, which could be indicative of the Penobscot tailings.

Analyte concentrations were generally low in Reach 6. The generally lower concentrations in Reach 6 may be the result of less erosion from the adjacent upstream reaches and increased stream flow. Reach 4, which encompasses tailings pile TP-5, also generally exhibited low analyte concentrations, but to a lesser degree than Reach 6. In Reach 4, Dog Creek is incised to base grade (i.e., native stream gravel) and does not appear to be a significant source of tailings erosion.

Table 3-11. Laboratory Chemistry Summary Statistics for Stream Sediments by Reach

Reach	Mean (excluding duplicates) pH	As	Cd	Cu	Pb	Hg	Sb	Zn	Total CN
1	6.8	331.0	14.0	540.0	1238.5	4.6	13.3	2250.0	0.4
2	7.1	628.8	15.5	435.3	1390.0	1.2	18.0	2597.5	0.7
3	7.1	537.4	22.4	622.7	1287.4	3.2	17.1	3255.7	0.9
4	7.2	398.4	10.6	373.9	821.0	0.9	13.9	1737.1	0.9
5	6.9	367.1	14.1	433.7	898.9	3.0	15.3	2055.7	0.5
6	6.3	159.0	8.8	328.8	516.8	1.3	8.0	1324.0	0.7
7	6.9	307.6	13.8	574.0	1391.8	3.6	30.2	2252.0	0.5
8	6.7	264.4	11.8	380.8	918.8	3.3	14.6	1800.0	0.7

Reach	Median (excluding duplicates) pH	As	Cd	Cu	Pb	Hg	Sb	Zn	Total CN
1	6.75	292	14	451	924	1.9	10	2130	0.25
2	7.2	617	13	375.5	1130	1.3	18	2245	0.79
3	7.2	543	26	596	1360	3.6	15	3640	0.76
4	7.4	308	10	344	767	0.5	13	1680	0.83
5	6.9	319	14	446	782	3.4	12	2170	0.52
6	6.3	149	7	281	473	1.2	8	1080	0.92
7	6.8	286	14	568	1150	3.8	21	2220	0.58
8	6.9	312	12	384	776	3.3	14	1740	0.72

Reach	Maximum (excluding duplicates) pH	As	Cd	Cu	Pb	Hg	Sb	Zn	Total CN
1	7	541	21	1060	2350	14	27	3170	0.68
2	7.2	747	26	711	2400	1.8	20	3990	0.84
3	7.2	969	29	825	1450	5.3	22	3920	1.8
4	7.5	976	17	583	1230	2.2	22	2590	1.5
5	7.1	641	17	587	1260	4.3	27	2520	0.63
6	7	212	12	497	808	2.5	12	1820	1
7	7.4	546	16	847	2830	5.5	73	2960	0.95
8	7	371	16	456	1200	4.1	16	2420	1.3

Reach	Median Stream Sediment Concentration/Mean Background Concentration pH	As	Cd	Cu	Pb	Hg	Sb	Zn	Total CN
1	0.96	1.24	2.80	7.16	4.50	3.80	2.35	3.59	NC
2	1.02	2.63	2.60	5.96	5.50	2.60	4.24	3.79	NC
3	1.02	2.31	5.20	9.46	6.62	7.20	3.53	6.14	NC
4	1.05	1.31	2.00	5.46	3.73	1.00	3.06	2.84	NC
5	0.98	1.36	2.80	7.08	3.81	6.80	2.82	3.66	NC
6	0.89	0.63	1.40	4.46	2.30	2.40	1.88	1.82	NC
7	0.96	1.22	2.80	9.02	5.60	7.60	4.94	3.75	NC
8	0.98	1.33	2.40	6.10	3.78	6.60	3.29	2.94	NC

NC - Not calculated

American Gulch enters Dog Creek at the upstream end of Reach 5. The drainage area of American Gulch is nearly the same size as the Dog Creek drainage above Reach 5. Therefore, Dog Creek should have a significant increase in stream flow below the confluence with American Gulch. Reach 5, which contains tailings pile TP-6, is characterized by a series of small beaver dams and braided channels, which would tend to attenuate peak flows and limit erosion through this reach. TP-6 is also well vegetated and also does not appear to be a significant source of tailings erosion. By the time Dog Creek reaches the lower end of TP-6, it flows in a single channel through Reach 6. The increased stream flow in Dog Creek, flowing in a single channel could have potentially flushed tailings impacted sediment in Reach 6. This together with the apparently minor amount of tailings erosion from Reaches 4 and 5 would explain the overall low stream sediment analyte concentrations in Reach 6.

3.5 DOG CREEK FLOODPLAIN TAILINGS

During the reconnaissance stream sediment sampling, several areas of significant tailings deposition were encountered in the Dog Creek floodplain. These areas are outside of the identified tailings piles and are believed to be the result of fluvial deposition and impoundment of tailings behind beaver dams. Hyder (1934) indicates that some of these tailings deposition areas may be from early operations at the Penobscot Mine. Reprocessing and discharge of tailings from the Bald Butte millsite, as well as subsequent tailings erosion, are also probable contributors to these tailings areas.

Several shovel pits (TP-A through TP-G) were excavated in the potential floodplain tailings areas. The largest of these areas is located in stream Reach 3 (Figure 3-8). The Reach 3 floodplain tailings are impounded by two separate beaver dams. The axis of the beaver dams are perpendicular to the stream and span the entire width of the floodplain. The tailings are located in a wide flat area behind the beaver dam. The floodplain is well vegetated with thick grass, small deciduous trees and willows. Other smaller areas of floodplain tailings were identified near shovel pit locations TP-C, TP-D, TP-E, TP-F, and TP-G (Figure 3-8). Selected representative samples of the suspected tailings materials were collected for evaluation via XRF methods.

The XRF data were used to evaluate whether the suspected floodplain tailings materials are indeed tailings. The sum of the XRF copper, lead and zinc concentrations (XRF Cu+Pb+Zn) were used as a statistic to compare with the XRF results from the known tailings waste sources evaluated during the Bald Butte Millsite characterization. Table 3-12 provides summary statistics for XRF Cu+Pb+Zn from Bald Butte Millsite tailings waste sources, as well as background and potential repository source samples, for comparison with the suspected floodplain tailings. In the background samples, the mean and maximum XRF Cu+Pb+Zn concentrations were 460 ppm and 618 ppm, respectively. The mean and maximum XRF Cu+Pb+Zn concentrations from the repository area, which is located away from waste sources and should be similar to background, were 329 and 465, respectively. The tailings piles TP-1 through TP-6 and the Vat Leach Tank area had mean XRF Cu+Pb+Zn concentrations ranging from 2,799 to 5,462 ppm, and maximum XRF Cu+Pb+Zn concentrations ranging from 3,032 to 11,532 ppm.

TABLE 3-12 SUMMARY STATISTICS FOR XRF Cu+Pb+Zn FOR BALD BUTTE MILLSITE TAILINGS, BACKGROUND, REPOSITORY AND BORROW SOURCES

		XRF Cu+Pb+Zn (ppm)		
Source Area	No. Samples	Maximum	Mean	Minimum
TP-1	24	5,259	2,799	1,202
TP-2	11	10,580	4,930	1,730
TP-3	5	5,214	4,285	3,520
Vat	9	7,708	5,462	2,348
TP-4	2	3,032	2,630	2,227
TP-5	13	11,532	4,393	887
TP-6	14	6,829	2,862	29
BG	6	618	460	293
RP	4	465	329	108

The XRF results for the floodplain tailings samples are summarized in Table 3-13. The XRF Cu+Pb+Zn concentrations for floodplain tailings samples TP-A, TP-B, TP-D and TP-F range from 2,933 to 5,004 ppm. These concentrations are significantly greater than both the background and repository area samples, and are in the same range as the known tailings sources, indicating that the suspected floodplain tailings are indeed tailings with elevated metal concentrations.

TABLE 3-13 SUMMARY OF FLOODPLAIN TAILINGS XRF ANALYTICAL RESULTS

	XRF Concentration (ppm)			
Sample ID	Cu	Pb	Zn	Cu+Pb+Zn
TP-A	698.7	3123.4	1182.3	5004.3
TP-B	394.6	1748.0	2401.4	4544.0
TP-D	435.8	906.9	1816.5	3159.2
TP-F	383.4	1831.5	718.5	2933.4

The floodplain tailings areas were discovered during the stream sediment sampling, and as such, were not part of the original scope of the site characterization. Therefore, detailed site characterization and topographic surveys were not completed on these sources. The characterization of these sources was at a reconnaissance level (i.e., to evaluate the presence or absence of tailings) rather than at the detailed level that was completed on the previously known tailings sources. Test pits were excavated in areas that were suspected of containing tailings to confirm the presence of the tailings and, in some cases, to collect a representative sample for XRF analysis.

The inherent variable thickness of the fluvial tailings deposition, together with the irregular deposition patterns, make it difficult to provide accurate volume estimates, especially without the aid of topographic surveys and more test pits. To provide a general idea of the potential tailings quantities, order-of-magnitude volume estimates have been made based on the plan areas from aerial photographs and the limited tailings thickness data that are currently available. The depth of tailings at shovel pits TP-A and TP-B were 2.2 and 2.3 feet, respectively. Based on GPS coordinates and interpretation of aerial photographs, the area of floodplain surrounding TP-A and TP-B are 4,616 and 4,801 square feet, respectively. Based on a tailings depth of 2.0 feet, the volumes of the TP-A and TP-B tailings areas are 3,680 and 3,830 cubic yards, respectively.

No volume estimates were made for the floodplain tailings below tailings pile TP-6 (shovel pits TP-C, TP-D, TP-E and TP-F). These tailings areas are generally less well defined and have more variable thickness than at TP-A and TP-B.

3.6 ASSESSMENT OF AIRBORNE PARTICULATE EMISSIONS

The principal waste sources in the Bald Butte Millsite and Devon/Sterling and Albion Mines areas are mill tailings and waste rock piles. Waste rock pile gradations are typically coarse grained containing abundant rock material. These waste sources thus contain lesser fine sediment that could be a source for airborne particulate emissions. The mill tailings typically are very fine grained to fine grained and consist of silt, sand and clay. The near surface tailings may exhibit floury textures which when disturbed create dust emissions. Although some of the tailings have vegetation, there are significant areas of exposed tailings with little to no vegetation cover. Laboratory chemistry results for composite tailings indicate that they contain a polymetallic suite along with total cyanide. Laboratory analyses indicate that a number of elements of environmental concern may be significantly elevated above background soil concentrations and these include As, Cd, Hg, Pb and total cyanide. The range of concentrations for these parameters is summarized in Table 3-14. These potential airborne contaminants are of concern for there is field evidence to indicate that the barren tailings areas, especially in tailings piles TP-1 and TP-2, are used for recreation. These recreational uses include ATV/motorcycle riding, target shooting, camping, parties and fishing in the main pond area in TP-1. The tailings with the greatest aerial exposures, i.e. non-vegetated, are TP-1, TP-2 and TP-3. These areas are also the most accessible by vehicles. The remaining tailings piles, TP-4/Vat Leach area, TP-5 and TP-6 are not very accessible or have moderately abundant vegetation and/or water coverage.

TABLE 3-14 SUMMARY OF THE RANGE OF METAL AND TOTAL CYANIDE CONCENTRATIONS IN MILL TAILINGS

Tailings Area	Range of Concentration (mg/Kg)				
	As	Cd	Hg	Pb	Total CN
TP-1	60-150	5-18	3.7-8.7	891-1900	<0.5-5.5
TP-2	11-19	10-20	3.7-12	1460-2380	<0.5-24
TP-3	137-251	13-15	3.4-6.3	2180-2280	<0.5-0.64
TP-4 & Vat Leach Tank Area	135-163	22	4.6-7.6	636-2670	<0.5-4.2
TP-5	188-358	5-22	3.9-13	1210-4900	<0.5-1.6
TP-6	27-157	<1-21	<1-6.2	37-2100	<0.5

3.7 ASSESSMENT OF PHYSICAL HAZARDS

The physical hazards in the Bald Butte Millsite and Devon/Sterling and Albion Mines areas are limited. The Bald Butte mill appears to have burned and little remains with the exception of minor wood and metal debris. The mill was multiple level and the rock foundation facing walls for the levels are still intact. The mill levels are bench-like structures that could pose a fall hazard. Partially collapsed accesses to underground mine workings include a shaft on waste rock pile WR-1 and an adit near waste rock pile WR1A. Three wooden structures that are reasonably intact include a pump house building in the tailings pile TP-1 area, a building shell on waste rock pile WR2A and the hopper tank structure near the Vat Leach Tank area. The Vat Leach Tank area contains the most wood and metal debris associated with the former wooden cyanide vat leach tanks. Where wood debris is present, rusted nails are common.

Empty drums and lids occur in a number of areas but are concentrated in the Vat Leach Tank area, near the hopper tank structure, and in an area immediately east of tailings pile TP-1. Most of these are empty and generally collapsed drums that probably contained cyanide used in the tailings reprocessing operations. A representative composite sample, 25-179-DASS-1, was laboratory analyzed for the same parameters as the tailings and the results are summarized in Table 3-4. The data indicate that the soils in the drum disposal area east of TP-1 show very elevated total cyanide (95 mg/kg) and Hg (618 mg/Kg). Some drums are also located near the toe of the TP-2 dam and one of these 55-gallon drums is full of a white chemical believed to be sodium hydroxide. This chemical was most likely used for pH control in the cyanide vat leach operations and is designated a hazardous material. Another white chemical material occurs in scattered piles and associated with some small remnant tanks in the hopper tank area. This material is most likely lime used for pH control in the cyanide vat leach operations. Four rusted, steel tanks that are approximately six feet deep are located in the tailings pile TP-1 area. These tanks were also used in the cyanide vat leach operation for tailings reprocessing. The tanks contain various materials including tailings, wood and metal debris and water.

Improperly disposed mill processing chemicals that are still on-site pose a direct contact hazard because they are caustic based on their strong alkaline pH. These chemicals occur in a drum, in former tank bottoms and in scattered piles.

3.8 POTENTIAL REPOSITORY SITE INVESTIGATION

The Bald Butte Millsite and Devon/Sterling and Albion Mines are located in a steep, narrow and mountainous drainage basin. Land ownership in the project area is mostly private on patented mining claims, with some small parcels of public land between claims. Land ownership outside of the immediate project area is mostly public land. Based on the terrain and the ownership status, the potential areas for mine/mill waste repositories are limited. During the site characterization, a potential mine/mill waste repository site north of the Bald Butte Millsite area was investigated. This work involved assessing land ownership, estimating potential repository storage volume and preliminary design, construction logistics, and an evaluation of the subsurface geology and shallow groundwater.

Site characterization results indicate that the mill tailings and waste rock piles WR-1 through WR-4 probably represent the most significant source of contaminants for impacting human health and the environment. The total estimated volume of mill tailings associated with the Bald Butte Millsite is approximately 70,650 cubic yards. The estimated total volume of waste rock piles WR-1 through WR-4 is approximately 2,874 cubic yards. In addition, native soil beneath tailings piles TP-1, TP-2, TP-4/vat leach area, TP-5 and TP-6 appear to have been impacted by tailings. Assuming that a one foot layer of native soil is removed from these sources, the volume of impacted soil would be approximately 33,830 cubic yards. The Devon/Sterling and Albion waste rock pile WR1A exceeds TCLP regulatory limits for lead and WR3A is possibly acid generating. The combined volume of the Devon/Sterling and Albion waste rock piles is approximately 32,940 cubic yards. The combined volume of all these sources is approximately 140,300 cubic yards.

The location of the proposed repository is shown on Figure 1-2. Figure 3-9 shows the potential repository site area, preliminary repository design topography and waste depth contours. This area was selected largely because it is one of the only areas in the vicinity of the project that is relatively open and flat. The base of the repository would be constructed on a bench above Dog Creek, and keyed into the hillside to the northeast. The property is exclusively owned by Hartmut and Inga Baitis. The preliminary repository volume is estimated at up to 152,530 cubic yards. The preliminary design indicates that the repository would occupy 4.86 acres, have an average thickness of 19.4 feet, a maximum waste thickness of 46 feet, and a total repository height of 64 feet. This is enough storage volume to contain the mill tailings, Bad Butte waste rock piles (WR-1 through WR-4), the Devon/Sterling and Albion waste rock piles (WR1A through WR3A) and impacted native soils beneath the tailings piles (approximately 140,300 cubic yards).

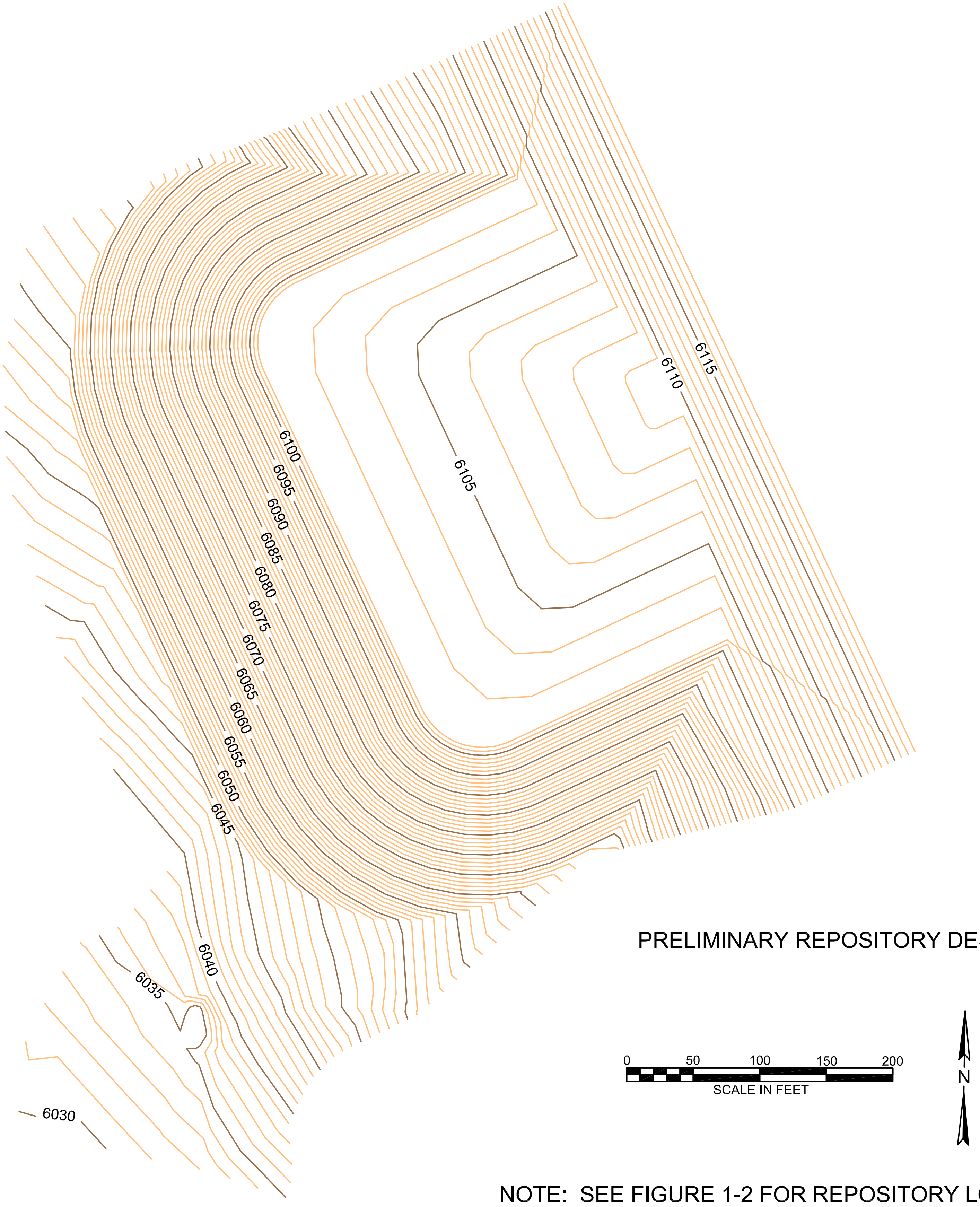
The depth to bedrock in the potential repository area is not known, but is thought to be relatively shallow. Refusal was met in backhoe pits RP-2 and RP-3, which are located on a bench above the access road, because of boulders at depths of approximately 4 feet. The material encountered on the bench consists of silty sand with moderate to abundant gravel. The amount and size of rock increased with depth. Test pits RP-1 and RP-4 were excavated closer to the drainage bottom. Water was encountered in test pits RP-1 and RP-4 at depths of 5 feet and 7.8 feet below the ground surface, respectively. The material encountered in the lower portion of the repository was silty clay with moderate gravel (RP-1) and a stiff clay (RP-4). The clay in RP-4 extended to a depth greater than 7.8 feet.

Several other factors should be considered prior to using this potential repository area. First, the area has been previously logged and there are abundant tree stumps throughout the repository area that would need to be cleared, particularly if a bottom liner was to be installed. There is also abundant rock present on the surface. Second, there is a marshy area approximately 50 feet west of test pit RP-1, and a small stream channel that would run near the toe of the repository. Third, the clayey subgrade material in the lower portion of the repository would need to be characterized for potential settlement. Subsurface soil samples were collected from test pits RP-2, RP-3 and RP-4 for future analysis of geotechnical parameters.

3.9 POTENTIAL BORROW SOURCE INVESTIGATION

The available areas for potential cover soil borrow sources are limited in the Bald Butte Millsite and Devon/Sterling and Albion Mines project areas due to the steep, mountainous topography and the narrow drainage corridors. The two widest drainage bottom areas, TP-1/TP-2 and TP-6 were utilized for mill tailings disposal. In the case of the TP-6 area, nearly all of the drainage bottom is a wetlands environment. The wetlands were most likely formed as a result of the increased water holding capacity of the fine-grained tailings. The remainder of the Dog Creek drainage bottom in the project area is very narrow and bordered by steep topography.

In the tailings pile TP-1 and TP-2 areas, a number of earthen dams are present and appear to be native soil materials. The estimated volume of these earthen dams is 7,200 cubic yards. In other projects, these earthen dams have been used as cost effective sources for cover soils in reclamation. These structures were evaluated as potential sources of cover soil. Revegetation and particle size analytical results are summarized in Table 3-15. The revegetation and particle size results indicate that the earthen dams would meet the cover soil specifications (MDSL/AMRB, 1991). The range of organic matter contained in the earthen dams is 0.43 weight percent (wt. %) to 2.49 wt. %. Some organic amendment may be required if this material



PRELIMINARY REPOSITORY DESIGN

NOTE: SEE FIGURE 1-2 FOR REPOSITORY LOCATION

WASTE DEPTH CONTOURS

Olympus Technical Services, Inc.	MONTANA DEQ/MINE WASTE CLEANUP BUREAU BALD BUTTE MILLSITE AND MINES LEWIS & CLARK COUNTY, MONTANA	BALD BUTTE MILLSITE AREA POTENTIAL REPOSITORY SITE	FIGURE 3-9

DESIGN:	DRAWN: KSR	CHECKED: CRS	APPROVED:	DATE: 9/2004	JOB NO: A1432	SCALE: AS SHOWN	FILENAME: A1432BButte.dwg

Table 3-15. Laboratory Revegetation and Miscellaneous Soils Particle Size Results

	Physical Characteristics				Chemical Characteristics						
Sample ID	Sand (wt%)	Silt (wt%)	Clay (wt%)	Texture*	pH (S.U.)	Conductivity, Saturated Paste (mmhos/cm)	Saturation (wt%)	Organic Matter (wt%)	Phosphorus mg/Kg	Nitrate + Nitrite as N mg/Kg	Potassium mg/Kg
25-179-BS1	30.0	47.5	22.5	L	5.8	0.30	39.8	2.49	18	9.3	210
25-179-BS2	42.5	40.0	17.5	L	6.0	0.37	39.9	2.00	11	7.9	190
25-179-BS3	55.0	30.0	15.0	L	5.5	0.19	20.7	0.43	14	<0.5	50
25-179-RP-1	25.0	57.5	17.5	SL	6.2	0.18	41.7	1.04	35	0.7	200

*C=Clay, S=Sand(y), Si=Silt(y), L=Loam(y)

Miscellaneous Soils Particle Size Results

	Weight Percent Retained					Percent Finer by Weight								
Sample ID	Gravel	Sand			Silt/Clay	Gravel	Sand			Silt/Clay				
Sieve Size	3/4-in	#4	#10	#40	#200	3/4-in	#4	#10	#40	#200	Percent Sand	Percent Silt	Percent Clay	Soil Texture
Opening (Inches)	0.75	0.187	0.0661	0.0106	0.0029	0.75	0.187	0.0661	0.0106	0.0029				
25-179-TP1-5	6.2	26.5	27.2	22.3	9.5	93.8	67.3	40.1	17.8	8.3	35.0	42.5	22.5	Loam
25-179-TP2-4	2.4	14.4	15	20.1	8.8	97.6	83.2	68.2	48.1	39.3	32.5	47.5	20.0	Loam
25-179-RP1	2.1	18.7	12.3	32.4	15.1	97.9	79.2	66.9	34.5	19.4	25.0	57.5	17.5	Silty Loam
25-179-BS1	2.5	14.2	16.7	54.2	8.4	97.5	83.3	66.6	12.4	4.0	30.0	47.5	22.5	Loam
25-179-BS2	1.0	16.7	18.3	49.4	10.2	99.0	82.3	64.0	14.6	4.4	42.5	40.0	17.5	Loam
25-179-BS3	2.1	24.8	10.4	36.0	21.3	97.9	73.1	62.7	26.7	5.4	55.0	30.0	15.0	Loam

LEGEND

25-179-BS1 is a grab composite sample of TP-2 earthen dam; lt. brown silty sand + predom gravel w/lesser rock ≤ 4" dia.
25-179-BS2 is a grab composite sample of TP-2 earthen dam; fine-grained silty sand soil + gravel + minor rock ≤ 4" dia.
25-179-BS3 is a grab composite sample of TP-1 earthen dam; lt. tan silty sand soil + gravel + lesser rock ≤ 6" dia.
25-179-RP-1 is a grab composite sample of RP2 and RP3 test pits in potential repository area
25-179-TP1-5 is a composite of TP1-2-2.7-4.1, TP1-4-2.0-3.0, TP1-13-8.0-9.4, TP1-22-4.6-5.7; native soil beneath tailings
25-179-TP2-4 is a composite of TP2-3-1.1-2.0, TP2-4-3.1-3.8 and TP2-6-1.5-2.4; native soil beneath tailings

were used as cover soil. To further assess the earthen dam potential as cover soil, qualitative to semi-quantitative XRF screens of the samples were done. The data indicate that two elements of concern, As and Pb, can be elevated in the earthen dams. Arsenic concentrations range from 33 ppm to 222.6 ppm and Pb ranges from no detection to 1980 mg/Kg. The results indicate that some tailings have impacted the native soil earthen dams. Wind blown tailings dust is a likely source of these elevated contaminants in the surface areas of the dams.

Many of backhoe test pits and shovel/hand auger holes in tailings piles TP-1 and TP-2 intersected a native soil that resembles good topsoil-like material. Particle size analysis was run on one native soil composite sample in each tailings pile to evaluate the grain size distribution of this material beneath the tailings piles. The analytical results are summarized in Table 3-15. The gradations of this material would meet the cover soil specification (MDSL/AMRB, 1991). Laboratory analytical results (Table 3-4), however, indicate that the tailings are impacting the underlying native soils. The native soils are elevated in As (216 - 286 mg/Kg), Cd (8 - 12 mg/Kg), Hg (<1 - 1.2 mg/Kg), Pb (204 - 1900 mg/Kg), Zn (1340 - 2190 mg/Kg) and total cyanide (1.4 - 2.5 mg/Kg). These results indicate that volume of native soil that might be available beneath the tailings piles in this area would very limited.

Additional cover soil source materials were evaluated in the potential mine/mill waste repository area. Test pits were excavated to evaluate the geology and assess the shallow groundwater conditions. A representative composite sample was collected from test pits RP2 and RP3 for revegetation and particle size gradation analysis. The results are summarized in Table 3-15. The data indicate that the native soil materials in the potential repository site would meet the cover soil specifications (MDSL/AMRB, 1991). As with the earthen dams, an organic amendment and fertilizer would likely be required for this material. The composite sample was also XRF screened and the data indicate that the analytical results for native soils in the potential repository area are consistent with background native soil concentrations. Based on the presence of shallow groundwater in a portion of the potential repository area (see Section 3.8), the depth of excavation in the repository would be limited.

The flat area east of the TP-1 tailings pile lobe that extends toward the mill area did not have any field evidence of tailings. Field observations of native soil excavated from shovel pits in this area suggest that this material may be a potential cover soil borrow source. The volume, however, may be limited by the depth to shallow groundwater.

The preliminary evaluation of potential cover soil borrow sources in the patented claim blocks containing the project area indicates that cover soil sources appear to be limited. The majority of land surrounding the project area is controlled by the Helena National Forest. Any further investigation of potential cover soil borrow sources within a reasonable distance of the project area would require some agreement with this agency.

4.0 SUMMARY OF THE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The summary of the applicable or relevant and appropriate requirements (ARARs) was compiled from a draft document describing ARARs for abandoned mine sites produced by the Montana Department of Environmental Quality - Mine Waste Cleanup Bureau (DEQ-MWCB). These ARARs, along with those prepared by ARCO for the Streamside Tailings Operable Unit (ARCO, 1995) and the Montana Department of Environmental Quality-Hazardous Waste Site Cleanup Bureau for mine sites, were reviewed by Olympus to develop a listing of potential federal and state ARARs for the Bald Butte Millsite and Devon/Sterling and Albion Mines project. The federal and state ARARs are summarized in Table 4-1 and Table 4-2, respectively. Appendix A provides detailed descriptions of potential federal and state ARARs. The description of the federal and state ARARs includes summaries of legal requirements that, in many cases, attempt to set out the requirement in a simple fashion useful in evaluating compliance with the requirement. In the event of any inconsistency between the law itself and the summaries in this section, the ARAR is ultimately the requirement as set out in the law, rather than any paraphrase provided here.

TABLE 4-1 SUMMARY OF PRELIMINARY FEDERAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS.

Standard, Requirement Criteria Or Limitation	Citation	Description	ARAR Status
FEDERAL CONTAMINANT-SPECIFIC			
Safe Drinking Water Act	42 USC §§ 300f		
National Primary Drinking Water Standards	40 CFR Part 141	Establishes health-based standards (MCLs) for public water systems.	Relevant and Appropriate
National Secondary Drinking Water Standards	40 CFR Part 143	Establishes welfare-based standards (secondary MCLs) for public water systems.	Relevant and Appropriate
Clean Water Act	33 USC. § 1251-1375		
Water Quality Standards	40 CFR Part 131	Sets criteria for water quality based on toxicity to aquatic organisms and human health.	Applicable
National Pollutant Discharge Elimination System (NPDES)	40 CFR Part 122	General permits for discharge from construction.	Applicable
Clean Air Act	42 USC § 7409		
National Primary and Secondary Ambient Air Quality Standards	40 CFR Part 50	Air quality levels that protect public health.	Applicable
Resource Conservation and Recovery Act	42 USC § 6901		
Lists Of Hazardous Waste	40 CFR Part 261, Subpart D	Defines those solid wastes that are subject to regulation as hazardous wastes under 40 CFR Parts 262-265 and Parts 124, 270 and 271.	Applicable

TABLE 4-1 SUMMARY OF PRELIMINARY FEDERAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)

Standard, Requirement Criteria Or Limitation	Citation	Description	ARAR Status
FEDERAL LOCATION-SPECIFIC			
National Historic Preservation Act	16 USC § 470; 36 CFR Part 800; 40 CFR §6.301(b)	Requires Federal Agencies to take into account the effect of any Federally-assisted undertaking or licensing on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register of Historic Places and to minimize harm to any National Historic Landmark adversely or directly affected by an undertaking.	Applicable
Archaeological and Historic Preservation Act	16 USC § 469; 40 CFR § 6.301(c)	Establishes procedures to provide for preservation of historical and archaeological data which might be destroyed through alteration of terrain as a result of a Federal construction project or a Federally licensed activity or program.	Applicable
Protection of Wetlands Order	40 CFR Part 6, Appendix A, Executive Order No. 11,990	Avoid adverse impacts associated with destruction or loss of wetlands and avoid support of new construction in wetlands if a practicable alternative exists.	Applicable
Historic Sites, Buildings and Antiquities Act	16 USC §§ 461-467; 40 CFR § 6.301(a)	Requires Federal agencies to consider the existence and location of landmarks on the National Registry of Natural Landmarks to avoid undesirable impacts on such landmarks.	Applicable
Fish and Wildlife Coordination Act	16 USC §§ 661 et seq.; 40 CFR § 6.302(g)	Requires consultation when Federal department or agency proposes or authorizes any modification of any stream or other water body and adequate provision for protection of fish and wildlife resources.	Applicable
Floodplain Management Order	40 CFR Part 6 Executive Order No. 11,988	Requires Federal agencies to evaluate the potential effects of actions they may take in a floodplain to avoid the adverse impacts associated with direct development of a floodplain.	Applicable

TABLE 4-1 SUMMARY OF PRELIMINARY FEDERAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)

Standard, Requirement Criteria Or Limitation	Citation	Description	ARAR Status
Endangered Species Act	16 USC §§ 1531-1543; 40 CFR § 6.302(h); 50 CFR Part 402	Activities may not jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify a critical habitat.	Applicable
Bald Eagle Protection Act	16 USC §§ 668	Requires consultation with the USFWS during reclamation design and construction to ensure that any cleanup of the site does not unnecessarily adversely affect the Bald Eagle or Golden Eagle.	Applicable
Migratory Bird Treaty Act	16 USC §§ 703	Establishes a federal responsibility for the protection of the international migratory bird resource and requires consultation with the USFWS during reclamation design and construction to ensure the cleanup of the site does not unnecessarily impact migratory birds. Specific mitigative measures may be identified for compliance with this requirement.	Applicable
FEDERAL ACTION-SPECIFIC			
Clean Water Act	33 USC § 1342		
National Pollutant Discharge Elimination System (NPDES)	40 CFR Part 122	Requires permits for the discharge of pollutants from any point source into waters of the United States.	Relevant and Appropriate
Surface Mining Control and Reclamation Act	30 USC §§ 1201-1328	Protects the environment from effects of surface mining activities.	Relevant and Appropriate
	30 CFR Part 784	Governs underground mining permit applications and minimum requirements for reclamation and operations plans.	Relevant and Appropriate

TABLE 4-1 SUMMARY OF PRELIMINARY FEDERAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)

Standard, Requirement Criteria Or Limitation	Citation	Description	ARAR Status
Surface Mining Control and Reclamation Act (continued)	30 CFR Part 816	Outlines permanent program performance standards for surface mining activities.	Relevant and Appropriate
Hazardous Materials Transportation Regulations	49 USC §§ 5101-5105		
Standards Applicable to Transporters of Hazardous Waste	49 CFR Part 10	Regulates transportation of hazardous waste.	Relevant and Appropriate
Resource Conservation and Recovery Act			
Land Disposal	40 CFR Part 268	Establishes a timetable for restriction of burial of wastes and other hazardous materials.	Applicable
Criteria for Classification of Solid Waste Disposal Facilities and Practices	40 CFR Part 257	Establishes criteria for use in determining which solid waste disposal facilities and practices pose a reasonable probability of adverse effects on health or the environment and thereby constitute prohibited open dumps.	Applicable
Standards for Transporters of Hazardous Waste	40 CFR Part 263	Establishes standards which apply to persons transporting hazardous waste within the U.S. if the transportation requires a manifest under 40 CFR Part 262.	Applicable
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	40 CFR Part 264	Establishes minimum national standards which define the acceptable management of hazardous waste for owners and operators of facilities which treat, store, or dispose of hazardous waste.	Applicable

TABLE 4-1 SUMMARY OF PRELIMINARY FEDERAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)

Standard, Requirement Criteria Or Limitation	Citation	Description	ARAR Status
Occupational Safety And Health Act	29 USC § 655		
Hazardous Waste Operations and Emergency Response	29 CFR 1910.120	Defines standards for employee protection during initial site characterization and analysis, monitoring activities, materials handling activities, training & emergency response.	Applicable

TABLE 4-2 SUMMARY OF PRELIMINARY STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Standard, Requirement Criteria Or Limitation	Citation	Description	ARAR Status
STATE CONTAMINANT-SPECIFIC			
Montana Water Quality Act	75-101 et seq., MCA	Laws to prevent, abate, and control the pollution of state waters.	Applicable
Regulations Establishing Ambient Surface Water Quality Standards	ARM 17.30.606-630	Provides the water use classification for various streams and imposes specific water quality standards per classification.	Applicable
Regulations Establishing Ambient Surface Water Quality Nondegradation Standards	ARM 17.30.705-717	Applies nondegradation requirements to any activity which could cause a new or increased source of pollution to State waters and outlines review procedures.	Applicable
	ARM 17.30.1203	Technology-based treatment for MPDES permits.	Applicable
Montana Groundwater Pollution Control System Regulations	ARM 17.30.1006	Classifies groundwater into Classes I through IV based on the present and future most beneficial uses of the groundwater and establishes groundwater classification standards.	Applicable
Public Water Supplies Act	75-6-101, MCA	Establishes public policy of MT to protect, maintain, and improve the quality and potability of water for public water supplies and domestic uses.	Relevant and Appropriate
Public Water Supply Regulations	ARM 17.30.204	Establishes maximum contaminant levels (MCLs) for inorganic chemicals in community water systems.	Relevant and Appropriate
	ARM 17.30.205	Establishes the maximum turbidity contaminant levels for public water supply systems which use surface water in whole or in part.	Relevant and Appropriate

TABLE 4-2 SUMMARY OF PRELIMINARY STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)

Standard, Requirement Criteria Or Limitation	Citation	Description	ARAR Status
Clean Air Act Of Montana	75-2-101 MCA	Montana's policy is to achieve and maintain such levels of air quality as will protect human health and safety and, to the greatest degree practicable, prevent injury to plant and animal life and property.	Relevant and Appropriate
Air Quality Regulations	ARM 17.8.222	No person shall cause or contribute to concentrations of lead in the ambient air which exceed the following 90-day average: 1.5 micrograms per cubic meter of air.	Applicable
	ARM 17.8.220	No person shall cause or contribute to concentrations of particulate matter in the ambient air such that the mass of settled particulate matter exceeds the following 30-day average: 10 grams per square meter.	Applicable
	ARM 17.8.223	No person may cause or contribute to concentrations of PM-10 in the ambient air which exceed the following standard: 1) 24-hr. avg.: 150 micrograms per cubic meter of air, with no more than one expected exceedance per year; 2) Annual avg.: 50 micrograms per cubic meter of air.	Applicable
	ARM 17.8.308	States “no person shall cause or authorize the production, handling, transportation or storage of any material unless reasonable precautions to control emissions of airborne particulate matter are taken.”	Applicable
	ARM 17.8.304 (2)	States no person shall cause opacity of 20% or greater averaged over 6 consecutive minutes.	Applicable

TABLE 4-2 SUMMARY OF PRELIMINARY STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)

Standard, Requirement Criteria Or Limitation	Citation	Description	ARAR Status
Air Quality Regulations (continued)	ARM 17.8.341	Sets forth emission standards for hazardous air pollutants.	Applicable
	ARM 17.24.761	Requires a fugitive dust control program be implemented in reclamation operations.	Applicable
Occupational Health Act of Montana	50-70-101, MCA	The purpose of this act is to achieve and maintain such conditions of the work place as will protect human health and safety.	Applicable
Occupational Air Contaminants Requirements	ARM 17.74.102	Establishes maximum threshold limit values for air contaminants believed that nearly all workers may be repeatedly exposed day after day without adverse health effects.	Applicable
Occupational Noise Regulations	ARM 17.74.101	Addresses occupational noise levels and provides that no worker shall be exposed to noise levels in excess of specified levels.	Applicable
STATE LOCATION-SPECIFIC			
Floodplain and Floodway Management Act	76-5-401, MCA	Lists the uses permissible in a floodway and generally prohibits permanent structures, fill, or permanent storage of materials or equipment.	Applicable
	76-5-402 MCA	Lists the permissible uses within the floodplain but outside of floodway.	Applicable

TABLE 4-2 SUMMARY OF PRELIMINARY STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)

Standard, Requirement Criteria Or Limitation	Citation	Description	ARAR Status
Floodplain and Floodway Management Act (continued)	76-5-403, MCA	Lists certain uses which are prohibited in a designated floodway, including any change that will cause water to be diverted from the established floodway, cause erosion, obstruct the natural flow of water, or reduce the carrying capacity of the floodway, or the concentration or permanent storage of an object subject to flotation or movement during flood level periods.	Applicable
Floodplain Management Regulations	ARM 36.15.602	Uses allowed in the floodway which require a permit.	Applicable
	ARM 36.15.601	Open space uses allowed in the floodway without a permit.	Applicable
	ARM 36.15.216	The factors to consider in determining whether a permit should be issued to establish or alter an artificial obstruction or nonconforming use in the floodplain or floodway are set forth in this section.	Applicable
	ARM 36.15.603	Proposed diversions or changes in place of diversions must be evaluated by DNRC to determine whether they may significantly affect flood velocities.	Applicable
	ARM 36.15.604	Prohibits new artificial obstructions or nonconforming uses that will significantly increase the upstream elevation of the base flood 0.5 feet or significantly increase flood velocities.	Applicable

TABLE 4-2 SUMMARY OF PRELIMINARY STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)

Standard, Requirement Criteria Or Limitation	Citation	Description	ARAR Status
Floodplain Management Regulations (continued)	ARM 36.15.605	Identifies artificial obstructions and nonconforming uses that are prohibited within the designated floodway except as allowed by permit and includes a structure or excavation that will cause water to be diverted from the established floodway, cause erosion, obstruct the natural flow of water, or reduce the carrying capacity of the floodway. Solid waste disposal and storage of highly toxic, flammable, or explosive materials are also prohibited.	Applicable
	ARM 36.15.606	Identifies flood control works that are allowed with designated floodways pursuant to permit and certain conditions including: flood control levies and flood walls, riprap, channelization projects, and dams.	Applicable
	ARM 36.15.701	Describes allowed uses in the flood fringe.	Applicable
	ARM 36.15.703	Prohibited uses within the flood fringe including solid and hazardous waste disposal and storage of toxic, flammable, or explosive materials.	Applicable
	ARM 36.15.801	Allowed uses where the floodway is not designated or where no flood elevations are available.	Applicable

TABLE 4-2 SUMMARY OF PRELIMINARY STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)

Standard, Requirement Criteria Or Limitation	Citation	Description	ARAR Status
Natural Streambed and Land Preservation Standards	87-5-501-504, MCA	Fish and wildlife resources are to be protected and no construction project or hydraulic project shall adversely affect game or fish habitat.	Applicable
	ARM 36.2.410	Defines project information which applicant must provide to district and provides that stream projects must be designed and constructed to minimize adverse impacts to stream, future disturbances to the stream, and erosion; temporary structures used during construction must handle reasonably anticipated high flows; channel alteration must be designed to retain original stream length or otherwise provide for hydrologic stability; streambank vegetation must be protected except where removal is necessary and riprap, rock, or other material must be sized adequately to protect streambank erosion.	Applicable
Antiquities Act	22-3-424, MCA	Heritage and paleontological sites are given appropriate consideration.	Relevant and Appropriate
	22-3-433, MCA	Evaluation of environmental impacts include consultation with State Historic Preservation Officer (SHPO).	Relevant and Appropriate
	22-3-435, MCA	A heritage or paleontological site is to be reported to the SHPO.	Relevant and Appropriate
Cultural Resource Regulations	ARM 12.8.503-508	Procedures to ensure adequate consideration of cultural values.	Relevant and Appropriate

TABLE 4-2 SUMMARY OF PRELIMINARY STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)

Standard, Requirement Criteria Or Limitation	Citation	Description	ARAR Status
STATE ACTION SPECIFIC			
Montana Water Quality Act	75-5-605, MCA	Pursuant to this section, it is unlawful to cause pollution of any state waters, to place any wastes in a location where they are likely to cause pollution of any state waters, to violate any permit provision, to violate any provision of the Montana Water Quality Act, to construct, modify, or operate a system for disposing of waste (including sediment, solid waste and other substances that may pollute state waters) which discharge into any state waters without a permit or discharge waste into any state waters.	Applicable
Montana Surface Water Quality Regulations	ARM 17.30.635	Industrial waste must receive treatment equivalent to the best practicable available control technology.	Applicable
	ARM 17.30.607-629	Provides for classification of state waters.	Applicable
	ARM 17.30.637	Requires that the State's surface waters be free from, among other things, substances that will create concentrations or combinations of materials that are harmful to human, animal, plant, or aquatic life. Moreover, no waste may be discharged and no activities may be conducted that can reasonably be expected to violate any of the standards.	Applicable

TABLE 4-2 SUMMARY OF PRELIMINARY STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)

Standard, Requirement Criteria Or Limitation	Citation	Description	ARAR Status
Nondegradation of Water Quality	ARM 17.30.705-717	Applies nondegradation requirements to any activity which would cause a new or increased source of pollution to state waters and outlines review procedures.	Applicable
Montana Groundwater Act			
Montana Groundwater Pollution Control System Regulations	ARM 17.30.1011	Requires that any groundwater whose existing quality is higher than the standard for its classification must be maintained at that high quality in accordance with 75-5-303, MCA, and ARM 17.30.701 et. seq.	Applicable
	ARM 17.30.1006	Classifies groundwater into Classes I through IV based on the present and future most beneficial uses of the groundwater and establishes groundwater classification standards.	Applicable
Clean Air Act Of Montana	75-2-101 MCA	Montana's policy is to achieve and maintain such levels of air quality as will protect human health and safety and, to the greatest degree practicable, prevent injury to plant and animal life and property.	Applicable
Air Quality Requirements	ARM 17.8.222	No person shall cause or contribute to concentrations of lead in the ambient air which exceed the following 90-day average: 1.5 micrograms per cubic meter of air.	Applicable
	ARM 17.8.604	Lists certain wastes that may not be disposed of by open burning.	Applicable

TABLE 4-2 SUMMARY OF PRELIMINARY STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)

Standard, Requirement Criteria Or Limitation	Citation	Description	ARAR Status
Air Quality Requirements (continued)	ARM 17.8.308-310	No person shall cause or authorize the production, handling, transportation or storage of any material unless reasonable precautions to control emissions of airborne particulate matter are taken.	Applicable
Montana Solid Waste Management Act	75-10-201, MCA	Public policy is to control solid waste management systems to protect the public health and safety and to conserve natural resources whenever possible.	Applicable
Solid Waste Management Regulations	ARM 17.50.505	The standards for solid waste disposal are set forth in this provision.	Applicable
	ARM 17.50.510	General operational and maintenance requirements for solid waste management facilities.	Applicable
	ARM 17.50.523	Solid waste must be transported In such a manner as to prevent its discharge, dumping, spilling or leaking from the transport vehicle.	Applicable
Montana Hazardous Waste Act and Underground Storage Tank Act	5-10-402, MCA	It’s the policy of the State to “protect the public health and safety, the health of living organisms, and the environment from the effects of the improper, inadequate, or unsound management of hazardous wastes”.	Applicable

TABLE 4-2 SUMMARY OF PRELIMINARY STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)

Standard, Requirement Criteria Or Limitation	Citation	Description	ARAR Status
Montana Hazardous Waste Regulations	ARM 17.54.701,702 and 705	By reference to federal regulatory requirements, these sections establish standards for all permitted hazardous waste management facilities. 1) 40 CFR 264.11 (referenced by ARM 17.54.702) establishes that hazardous waste management facilities must be closed in such a manner as to minimize the need for further maintenance and to control, minimize or eliminate, to the extent necessary to protect public health and the environment, post-closure escape of hazardous wastes, hazardous constituents, leachate, contaminated runoff or hazardous waste decomposition products to the ground or surface waters or the atmosphere. 2) 40 CFR 264.228(a) (incorporated by reference by ARM 17.54.702) requires that at closure, free liquids must be removed or solidified, the wastes stabilized and the waste management unit covered. 3) 40 CFR 264.228 and 310 (incorporated by reference by ARM 17.54.702) requires that surface impoundments and landfill caps must: (a) provide long-term minimization of migration of liquids through the unit; (b) function with minimum maintenance; (c) promote drainage and minimize erosion or abrasion of the final cover; d) accommodate settling and subsidence; and (e) have a permeability less than or equal to the permeability of the natural subsoil present.	Relevant and Appropriate

TABLE 4-2 SUMMARY OF PRELIMINARY STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)

Standard, Requirement Criteria Or Limitation	Citation	Description	ARAR Status
Montana Hazardous Waste Regulations (continued)	ARM 17.54.701,-702 and 705	4) 40 CFR 264.119 (incorporated by reference in ARM 17.54.702) requires that a map be provided showing the dimensions of waste disposal units, together with the types and amounts of waste disposed of in each unit. Additionally, the owner must record a deed restriction, in accordance with state law, that will in perpetuity notify potential purchasers that the property has been used for waste disposal and that its use is restricted.	Relevant and Appropriate
	ARM 17.54.111-113	Establishes permit conditions, duration of permits, schedules of compliance, and requirements for recording and reporting.	Relevant and Appropriate
<u>Montana Strip and Underground Mine Reclamation Act</u>	82-4-231, MCA	Sets forth objectives that require the operator to prepare a plan and to reclaim and revegetate the land affected by his operation.	Relevant and Appropriate
	82-4-233, MCA	Requires that after the operation has been backfilled, graded, topsoiled and approved, the operator shall establish a vegetative cover on all impacted lands. Specifications for the vegetative cover and performance are provided.	Relevant and Appropriate
Backfilling and Grading Requirements	ARM 17.24.501	Gives general backfilling and grading requirements.	Relevant and Appropriate
	ARM 17.24.519	The operator may be required to monitor settling of regraded areas.	Relevant and Appropriate

TABLE 4-2 SUMMARY OF PRELIMINARY STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)

Standard, Requirement Criteria Or Limitation	Citation	Description	ARAR Status
Hydrology Requirements	ARM 17.24.631	Reclamation operations must be planned and conducted to minimize disturbance and to prevent material damage to the prevailing hydrologic balance.	Relevant and Appropriate
	ARM 17.24.633	Specifies that sediment controls must be maintained until the disturbed area has been restored and revegetated.	Relevant and Appropriate
	ARM 17.24.634	Drainage design shall emphasize pre-mining channel and floodplain configurations that blend with the undisturbed drainage system above and below; and will meander naturally; remain in dynamic equilibrium with the system; improve unstable pre-mining conditions; provide for floods; provide for long term stability of landscape; and establish a pre-mining diversity of aquatic habitats and riparian vegetation.	Relevant and Appropriate
	ARM 17.24.635-637	Sets forth requirements for temporary and permanent diversions.	Relevant and Appropriate
	ARM 17.24.638	Sediment control measures shall be designed using the best technology currently available to prevent additional sediment to streamflows, meet the more stringent of federal or state effluent limitation, and minimize erosion.	Relevant and Appropriate

TABLE 4-2 SUMMARY OF PRELIMINARY STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)

Standard, Requirement Criteria Or Limitation	Citation	Description	ARAR Status
Hydrology Requirements (continued)	ARM 17.24.640	Provides that discharge from sedimentation ponds, impoundments, and diversions shall be controlled by vegetation, energy dissipaters, riprap channels, and other measures, where necessary, to reduce erosion, prevent deepening or enlargement of stream channels, and to minimize disturbance of the hydrologic balance.	Relevant and Appropriate
	ARM 17.24.641	Sets methods for preventing drainage from acid-and toxic-forming spoils into ground and surface waters.	Relevant and Appropriate
	ARM 17.24.642	Prohibits permanent impoundments with certain exceptions, and sets standards for temporary and permanent impoundments.	Relevant and Appropriate
	ARM 17.24.643-646	Provides for groundwater and groundwater recharge protection, and surface and groundwater monitoring.	Relevant and Appropriate
	ARM 17.24.649	Prohibits the discharge, diversion, or infiltration of surface and groundwater into existing underground mine workings.	Relevant and Appropriate
Top Soiling, Revegetation, and Protection of Wildlife and Air Resource Regulations	ARM 17.24.701-702	Requirements for stockpiling soil.	Relevant and Appropriate
	ARM 17.24.703	Materials other than, or along with, soil for final surfacing of spoils or other disturbances must be capable of supporting the approved vegetation and post-mining land use.	Relevant and Appropriate

TABLE 4-2 SUMMARY OF PRELIMINARY STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)

Standard, Requirement Criteria Or Limitation	Citation	Description	ARAR Status
Top Soiling, Revegetation, and Protection of Wildlife and Air Resource Regulations (continued)	ARM 17.24.711	Requires a diverse, effective, and permanent vegetative cover of the same seasonal variety native to the area affected and capable of meeting the criteria set forth in 82-4-233, MCA shall be established on all areas of land affected except water areas and surface areas of roads.	Relevant and Appropriate
	ARM 17.24.713	Specifies that seeding and planting of disturbed areas must be conducted during the first appropriate period for favorable planting after final seedbed preparation; but not longer than 90 days after top soil placement.	Relevant and Appropriate
	ARM 17.24.714	According to this section, as soon as practical, a mulch or cover crop must be used on all regraded and resoiled areas to control erosion, to promote germination of seeds, and to increase moisture retention of soil until permanent cover is established.	Relevant and Appropriate
	ARM 17.24.716	Establishes the required method of revegetation and provides that introduced species may be substituted for native species as part of an approved plan.	Relevant and Appropriate
	ARM 17.24. 717	Whenever tree species are necessary, trees adapted for local site conditions and climate shall be used.	Relevant and Appropriate
	ARM 17.24.718	Soil amendments must be used as necessary to aid in the establishment of permanent vegetation; irrigation, management, fencing, or other measures may also be used after review and approval by the department.	Relevant and Appropriate

TABLE 4-2 SUMMARY OF PRELIMINARY STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)

Standard, Requirement Criteria Or Limitation	Citation	Description	ARAR Status
Top Soiling, Revegetation, and Protection of Wildlife and Air Resource Regulations (continued)	ARM 17.24.719	Livestock grazing on reclaimed land is prohibited until revegetation is established and can sustain managed grazing.	Relevant and Appropriate
	ARM 17.24.721	Section specifies that rills and gullies greater than 9 inches which form on the reclaimed area must be filled, graded or otherwise stabilized and the area reseeded or replanted.	Relevant and Appropriate
	ARM 17.24.723	Monitoring of vegetation, soils and wildlife.	Relevant and Appropriate
	ARM 17.24.724	Success of revegetation shall be measured on the basis of unmined reference areas.	Relevant and Appropriate
	ARM 17.24.726	Sets means of measuring productivity.	Relevant and Appropriate
	ARM 17.24.728	Sets requirements for composition of vegetation.	Relevant and Appropriate
	ARM 17.24.730 and 731	Revegetated area must furnish palatable forage in comparable quantity and quality during the same grazing period as the reference area. If toxicity to plants or animals is suspected, comparative chemical analysis may be required	Relevant and Appropriate
	ARM 17.24.733	Sets requirements and measurement standards for trees, shrubs, and half-shrubs.	Relevant and Appropriate

TABLE 4-2 SUMMARY OF PRELIMINARY STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)

Standard, Requirement Criteria Or Limitation	Citation	Description	ARAR Status
Top Soiling, Revegetation, and Protection of Wildlife and Air Resource Regulations (continued)	ARM 17.24.751	Required site activities must be conducted so as to avoid or minimize impacts to important fish and wildlife species, including critical habitat and any threatened and endangered species identified at the site.	Relevant and Appropriate
	ARM 17.24.761	Section requires fugitive dust control measures for site preparation and reclamation operations.	Relevant and Appropriate

5.0 RISK ASSESSMENT

Human and environmental health threats associated with exposure to mine waste characterized during the site characterization of the Bald Butte Millsite and Devon/Sterling and Albion Mine areas have been evaluated through a risk assessment process. The risks were evaluated in regards to site-specific chemical concentrations and applicable exposure pathways. This assessment follows risk assessment procedures for abandoned mine sites as developed by the DEQ-MWCB.

5.1 BASELINE HUMAN HEALTH RISK ASSESSMENT

The baseline human health risk assessment performed for the Bald Butte Millsite and Devon/Sterling and Albion Mine areas generally follows the Federal Remedial Investigation/Feasibility Study process for CERCLA (Superfund) sites (EPA, 1988). The baseline human health risk assessment examines the effects of taking no action at the site. This abbreviated assessment involves two steps: hazard identification and risk characterization. These tasks are accomplished by evaluating available data and selecting contaminants of concern (CoCs), and then characterizing overall risk by comparing the concentrations of CoCs in various media to previously derived cleanup goals. These previously derived cleanup goals include a risk assessment for recreational use at abandoned mine sites completed for the DEQ-MWCB (Tetra Tech, 1996) and the EPA Region III risk-based concentration table (Smith, 1996).

5.1.1 Hazard Identification

The objective of hazard identification is to identify the CoCs at the site that pose the greatest potential human health risk. Standard EPA criteria for this selection include: (1) those contaminants that are associated with and present at the site; (2) contaminants with average concentrations at least three times above background levels; (3) contaminants with at least 20% of the measured concentrations above the detection limit; and (4) contaminants with acceptable quality assurance/quality control results applied to the data.

Contaminants typically associated with mine and mill wastes include heavy metals and cyanide. Samples of mill tailings, waste rock, and soil collected from the Bald Butte Millsite and Devon/Sterling and Albion Mines projects were laboratory analyzed for total cyanide and the following thirteen metal and non-metal elements: antimony, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, silver and zinc. These analyses were supplemented by screening for a multi-element suite using a portable XRF analyzer. Reconnaissance stream sediments were laboratory analyzed for total cyanide and the following seven elements: antimony, arsenic, cadmium, copper, lead, mercury and zinc. Surface water samples used in the risk assessment were laboratory analyzed for thirteen elements as above and calcium for use in hardness determination.

The Bald Butte Millsite and Devon/Sterling and Albion Mines project area is large and includes a number of waste sources. Therefore, the site was divided into four subareas/waste source groups as presented in Table 5-1, and a risk assessment was completed on the waste sources in each group.

TABLE 5-1 BALD BUTTE MILLSITE AND DEVON/STERLING AND ALBION MINES SUBAREAS AND WASTE SOURCE GROUPS

Project Subarea	Waste Source Group
Bald Butte Millsite Tailings Subarea 1	TP-1, TP-2, TP-3, TP-4/Vat Leach/Hopper Tank
Bald Butte Millsite Tailings Subarea 2	TP-5 and TP-6
Bald Butte Millsite Waste Rock	WR-1, WR-2, WR-3 and WR-4
Devon/Sterling and Albion Mines Waste Rock	WR-1A, WR-2A, and WR-3A

The average concentration and multiplier above background for the elements analyzed in each waste source are shown in Table 5-2. Mean total cyanide concentrations are presented in Table 5-2. The multiplier of cyanide above background was not calculated because total cyanide was not analyzed in background soil samples. The CoC's for each group were evaluated based on the criteria listed above and are shown in Table 5-3. Total cyanide is not expected to be detected in significant concentrations in background soil samples. Therefore, cyanide was included as a CoC if it was present in a given waste source.

CoCs for surface water were selected based on exceedances of human health or Federal acute or chronic aquatic water standards. Lead exceeded acute or chronic aquatic water quality criteria in Dog Creek. Cadmium, lead and zinc exceeded acute or chronic aquatic water quality criteria in the unnamed tributary containing the Devon/Sterling and Albion Mines. Cadmium, copper, lead and zinc exceeded acute or chronic aquatic water quality criteria in the water discharging from the adit located in the unnamed tributary containing the Devon/Sterling and Albion Mines. Iron and manganese exceeded human health standards in Dog Creek and the unnamed tributary containing the Devon/Sterling and Albion Mines. The water discharging from the mine adit exceeded human health standards for cadmium, manganese and zinc (Montana HHS).

5.1.2 Exposure Scenarios

The following section presents the exposure assessment conducted for the Bald Butte Millsite and Devon/Sterling and Albion Mines. The exposure assessment identifies the potentially exposed population(s) and exposure pathways and estimates exposure point concentrations and contaminant intakes. The previously derived risk-based cleanup goals were calculated using two exposure scenarios: a recreational use scenario (Tetra Tech, 1996) and a residential use scenario (Smith, 1996).

The residential use risk-based concentrations involve residential occupation of the contaminated land with the maximum level of exposure occurring for a child 0-6 years old (soil ingestion route). The resultant risk-based concentrations were derived for this worst-case residential exposure scenario by EPA Region III (Smith, 1996). The soil ingestion, dust inhalation exposure routes and drinking water ingestion exposure were based on the soil and water concentrations presented in Table 5-4.

The waste sources in the Bald Butte Millsite and Devon/Sterling and Albion Mines projects are primarily located on patented mining claims, however, there is abundant public and private land adjoining the mining claims. It should be noted that the access to the waste sources is virtually unrestricted. Current human exposure to site-related contaminants is primarily related to recreational activities proceeding on and near the site.

Table 5-2. MEAN ELEMENT CONCENTRATIONS IN PROJECT SUBAREAS AND WASTE SOURCE GROUPS AND MULTIPLIER ABOVE BACKGROUND CONCENTRATION

Sample ID	Ag (mg/Kg)	As (mg/Kg)	Ba (mg/Kg)	Cd (mg/Kg)	Cr (mg/Kg)	Cu (mg/Kg)	Fe (mg/Kg)	Hg (mg/Kg)	Mn (mg/Kg)	Ni (mg/Kg)	Pb (mg/Kg)	Sb (mg/Kg)	Zn (mg/Kg)	CN (mg/Kg)
Bald Butte Millsite Subarea 1 (TP-1, TP-2, TP-3 and TP-4/Vat Leach/Hopper Tank)														
Tailings	8.6	165.2	132.3	15.5	15.5	734.6	16454.8	6.4	1812.9	8.4	1786.0	27.7	2435.0	3.9
	3.43 x	4.06 x	0.67 x	18.61 x	1.47 x	25.96 x	0.99 x	12.80 x	2.29 x	0.92 x	40.32 x	11.07 x	10.50 x	
Bald Butte Millsite Subarea 2 (TP-5 and TP-6)														
Tailings	11.3	180.4	142.4	14.6	8.9	740.4	12876.3	6.0	3565.8	5.5	1833.8	45.0	2152.7	ND
	4.52 x	4.43 x	0.72 x	17.59 x	0.84 x	26.16 x	0.77 x	11.90 x	4.50 x	0.60 x	41.40 x	17.98 x	9.28 x	
Bald Butte Millsite (WR-1, WR-2, WR-3 and WR-4)														
Waste Rock	53.4	7734.3	95.1	86.4	21.9	555.9	104557.1	ND	5477.3	26.1	27357.4	94.6	18092.7	NA
	21.36 x	190.03 x	0.48 x	104.10 x	2.09 x	19.64 x	6.27 x		6.91 x	2.84 x	617.55 x	37.84 x	77.99 x	
Devon/Sterling and Albion Mines														
Waste Rock	13.8	218.5	134.3	16.8	18.2	999.3	37216.7	ND	1538.5	13.3	1492.5	55.3	2547.3	NA
	5.52 x	5.37 x	0.68 x	20.24 x	1.73 x	35.31 x	2.23 x		1.94 x	1.45 x	33.69 x	22.12 x	10.98 x	
Mean Background Soil														
	2.5 [a]	40.7	198	0.83	10.5	28.3	16666.7	0.5 [a]	793.0	9.2	44.3	2.5 [a]	232.0	NA

x multiplier above mean background (x times greater than the mean)
[a] concentration less than lower detection limit; one half of lower detection used for calculation
[b] Less than 20% of the measured concentrations above the method detection limit
NA not analyzed
NC not calculated
ND concentration less than lower detection limit

TABLE 5-3 CONTAMINANTS OF CONCERN BY PROJECT SUBAREA AND WASTE TYPE

Project Subarea and Waste Source	CoCs
Bald Butte Millsite Tailings Subarea 1	Ag, As, Cd, Cu, Hg, Pb, Sb, Zn, CN
Bald Butte Millsite Tailings Subarea 2	Ag, As, Cd, Cu, Hg, Mn, Pb, Sb, Zn
Bald Butte Millsite Waste Rock	Ag, As, Cd, Cu, Fe, Mn, Pb, Sb, Zn
Devon/Sterling and Albion Mines Waste Rock	Ag, As, Cd, Cu, Pb, Sb, Zn

TABLE 5-4 SOIL AND WATER CONCENTRATIONS USED TO EVALUATE RESIDENTIAL EXPOSURES

Project Subarea	Soil Ingestion and Dust Inhalation	Drinking Water Ingestion
Bald Butte Millsite Tailings Subarea 1	Average concentrations observed in the near surface (0 to <2 feet) TP-2 and Vat Leach tailings areas from samples collected by Olympus in 2003.	Concentrations from surface water sample SW2 collected immediately downstream of Subarea 1 by Olympus in 2003.
Bald Butte Millsite Tailings Subarea 2	Average concentrations observed in the near surface (0 to <2 feet) TP-5 and TP-6 tailings areas from samples collected by Olympus in 2003.	Concentrations from surface water sample SW4 collected immediately downstream of Subarea 2 by Olympus in 2003.
Bald Butte Millsite Waste Rock	Average of near surface waste rock samples collected by Olympus from test pits in 2003. Sample depths ranged from 0 to <2 feet.	Concentrations from surface water sample SW2 collected downstream of the waste rock pile area by Olympus in 2003.
Devon/Sterling and Albion Mines Waste Rock	Average of near surface waste rock samples collected by Olympus from test pits in 2003. Sample depths ranged from 0 to <2 feet.	Concentrations from surface water sample SW3A collected immediately downstream of waste rock piles by Olympus in 2003.

The DEQ-MWCB has provided a measure of the health risks to recreational populations exposed to mine wastes in a report titled "Risk-based Cleanup Guidelines for Abandoned Mine Sites" (Tetra Tech, 1996). The risk-based guidelines were developed using a risk assessment that assumed four types of recreation populations: fishermen, hunters, gold panners/rockhounds and ATV/motorcycle riders. Field observations suggest that each of these uses has the propensity to occur in the Bald Butte Millsite. With the exception of fisherman, these uses are also likely to occur in the Devon/Sterling and Albion Mine sites. Therefore, the exposed populations used in developing the DEQ-MWCB risk-based guidelines appear to be applicable to exposures that could reasonably be expected within the Bald Butte Millsite and Devon/Sterling and Albion Mines. The maximum risk calculated for the applicable recreational exposure scenarios was for: 1) an ATV/motorcycle rider (mill tailings only); or 2) a rockhound/gold panner (waste rock and surface water only), or 3) a downstream fisherman (fish consumption only). A high level of recreational use was assumed for this site based on observations made during collection of data in 1993 for the DEQ-MWCB Abandoned Inactive Mine Scoring System (AIMSS), field observations during site characterization in 2003, and the relatively unrestricted site access. The soil ingestion and dust inhalation exposure routes for the ATV/motorcycle rider assumed a surface concentration equal to the average of near surface tailings samples collected from the Bald Butte Millsite tailings piles. The soil ingestion and dust inhalation exposure routes for the rockhound/gold panner assumed a concentration equal to the average waste rock samples collected from the Bald Butte Millsite waste rock piles WR-1 through WR-4 and the Devon/Sterling and Albion Mines waste rock piles WR1A through WR3A. The water ingestion route assumed the measured water concentrations for sample SW2 for the Bald Butte Millsite Tailings Subarea 2, SW4 for the Bald Butte Millsite Tailings Subarea 1, SW2 for the Bald Butte Millsite Waste Rock area and SW3A for the Devon/Sterling and Albion Mines Waste Rock area.

5.1.3 Toxicity Assessment

The toxicity assessment examines the potential for CoCs to cause adverse effects in exposed individuals and provides an estimate of the dose-response relationship between the extent of exposure to a particular contaminant and adverse effects. Adverse effects include both carcinogenic and noncarcinogenic health effects in humans. Sources of toxicity data include EPA's Integrated Risk Information System (IRIS, EPA, 1995), Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profiles, Health Effects Assessment Summary Tables (HEAST), and EPA criteria documents. Individual toxicity profiles for each CoC are not presented here, however, they are provided in the reference documents (Smith, 1996, Tetra Tech, 1996). The existing risk-based concentrations that were used to characterize risks from exposure to the CoCs for each exposure scenario are presented in Tables 5-5 and 5-6 for residential and recreational scenarios, respectively. The risk values correspond to a lifetime cancer risk of $1x10^{-6}$ (one in one million) or hazard quotients equal to 1.

5.1.4 Risk Characterization

5.1.4.1 Residential Land Use Scenario

The residential exposure assumptions utilized to estimate contaminant intakes were compared to the risk-based concentrations (RBCs) in Table 5-5. These data were used to calculate resultant human health noncarcinogenic Hazards Quotients (HQs) and carcinogenic risk values for each CoC. The results of the risk calculations for the residential land use scenario in the Bald Butte Millsite and Devon/Sterling and Albion Mines project subareas are summarized in Tables 5-7 through 5-10.

TABLE 5-5 RISK-BASED CONCENTRATIONS FOR CONTAMINANTS OF CONCERN FOR THE RESIDENTIAL SCENARIO

Contaminant of Concern	Residential Soil Ingestion (soil conc.) (mg/Kg)	Residential Dust Inhalation (soil conc.) (mg/Kg)	Residential Water Ingestion (ug/L)
Antimony	31	NA	15
Arsenic	23	380	11
Cadmium	39 (Noncarc)	920 (Noncarc) 920 (Carc)	18
Copper	3100	NA	1500
Iron	23000	NA	11000
Lead	400*	NA	15*
Manganese	1800	NA	840
Mercury	23	7	11
Silver	390	NA	180
Zinc	23000	NA	11000
Cyanide	1600	NA	730

Notes: NA = Not available
Noncarc = Noncarcinogenic
Carc = Carcinogenic
**Lead levels derived from EPA recommendations, not RBC table (Smith, 1996).*

TABLE 5-6 RISK-BASED CONCENTRATIONS FOR CONTAMINANTS OF CONCERN FOR THE RECREATIONAL, MAXIMUM USE SCENARIO

Contaminant of Concern	Recreational Soil Ingestion/Inhalation Waste Rock (mg/Kg)	Recreational Soil Ingestion/Inhalation Tailings (mg/Kg)	Recreational Water Ingestion (ug/L)	Recreational Fish Ingestion (water conc.) (ug/L)
Antimony	586	1040	204	2,150
Arsenic	323 (Noncarc) 1.39 (Carc)	569 (Noncarc) 2.17 (Carc)	153 (Noncarc) 0.66 (Carc)	36.7 (Noncarc) 0.16 (Carc)
Cadmium	1,750 (Noncarc)	3,150 (Noncarc) 38.9 (Carc)	256	66.5
Copper	54,200	96,600	18,900	996
Cyanide	11,100	19,300	10,200	NA
Iron	NA	NA	NA	NA
Lead	2,200	3,920	220	165
Manganese	7,330	1,330	2,560	33.7
Mercury	440	738	153	0.294
Silver	NA	NA	NA	NA
Zinc	440,000	784,000	153,000	34,400

Notes: Noncarc = Noncarcinogenic @ HQ=1
Carc = Carcinogenic @ Risk =1.0X10^{-6}
NA - No RBC available

HQ values exceed one for the residential land use scenario for the following CoCs at the following locations:

- arsenic (7.0435) and lead (5.1500) via soil ingestion, and mercury (1.1143) via dust inhalation at the Bald Butte Millsite Tailings Subarea 1;

Table 5-7. Summary of Noncarcinogenic Hazard Quotients (HQs) and Carcinogenic Risk Values for the Residential Land Use Scenario – Bald Butte Millsite Tailings Subarea 1

Contaminant of Concern	Soil Ingestion	Dust Inhalation	Water Ingestion	Total HQ by CoC
Noncarcinogenic HQ Summary				
Antimony	0.5710	NC	0.1667	0.7376
Arsenic	7.0435	0.42632	1.1818	8.6516
Cadmium	0.3846	0.0163	0.0278	0.4287
Copper	0.2725	NC	0.0033	0.2758
Cyanide	0.0014	NC	0.0000	0.0014
Lead	5.1500	0.0021	0.2000	5.3521
Mercury	0.3391	1.1143	0.0091	1.4625
Silver	0.0359	NC	0.0139	0.0498
Zinc	0.1091	NC	0.0018	0.1109
Total HQ	13.9071	1.5590	1.6044	17.0704
Carcinogenic Risk Summary				
Arsenic	3.77E-04	4.26E-07	2.89E-04	6.66E-04
Cadmium		1.63E-08		1.63E-08
Total Risk	3.77E-04	4.43E-07	2.89E-04	6.66E-04

NC - Not Calculated because no RBC provided in Smith, 1996

Table 5-8. Summary of Noncarcinogenic Hazard Quotients (HQs) and Carcinogenic Risk Values for the Residential Land Use Scenario – Bald Butte Millsite Tailings Subarea 2

Contaminant of Concern	Soil Ingestion	Dust Inhalation	Water Ingestion	Total HQ by CoC
Noncarcinogenic HQ Summary				
Antimony	2.5726	NC	0.0000	2.5726
Arsenic	8.3696	0.5066	1.1818	10.0580
Cadmium	0.2500	0.0106	0.0278	0.2884
Copper	0.2173	NC	0.0033	0.2206
Lead	6.1713	0.0025	0.9333	7.1071
Manganese	4.0590	NC	0.1548	4.2138
Mercury	0.2935	0.9643	0.0091	1.2669
Silver	0.0353	NC	0.0139	0.0491
Zinc	0.0728	NC	0.0009	0.0737
Total HQ	22.0412	1.4839	2.3249	25.8500
Carcinogenic Risk Summary				
Arsenic	4.48E-04	5.07E-07	2.89E-04	7.37E-04
Cadmium	NC	1.06E-08	NC	1.06E-08
Total Risk	4.48E-04	5.17E-07	2.89E-04	7.37E-04

NC - Not Calculated because no RBC provided in Smith, 1996

Table 5-9. Summary of Noncarcinogenic Hazard Quotients (HQs) and Carcinogenic Risk Values for the Residential Land Use Scenario – Bald Butte Millsite Waste Rock

Contaminant of Concern	Soil Ingestion	Dust Inhalation	Water Ingestion	Total HQ by CoC
Noncarcinogenic HQ Summary				
Antimony	3.0516	NC	0.1667	3.2183
Arsenic	336.2739	20.3534	1.1818	357.8092
Cadmium	2.2154	0.0939	0.0278	2.3371
Copper	0.1793	NC	0.0033	0.1827
Iron	4.5460	NC	0.0373	4.5832
Lead	68.3935	0.0274	0.2000	68.6209
Manganese	3.0429	NC	0.1548	3.1977
Silver	0.1369	NC	0.0139	0.1508
Zinc	0.7866	NC	0.0018	0.7885
Total HQ	418.6262	20.4747	1.7873	440.8882
Carcinogenic Risk Summary				
Arsenic	1.80E-02	2.04E-05	2.89E-04	1.83E-02
Cadmium	NC	9.39E-08	NC	9.39E-08
Total Risk	1.80E-02	2.04E-05	2.89E-04	1.83E-02

NC - Not Calculated because no RBC provided in Smith, 1996

Table 5-10. Summary of Noncarcinogenic Hazard Quotients (HQs) and Carcinogenic Risk Values for the Residential Land Use Scenario – Devon/Sterling and Albion Mines Waste Rock

Contaminant of Concern	Soil Ingestion	Dust Inhalation	Water Ingestion	Total HQ by CoC
Noncarcinogenic HQ Summary				
Antimony	1.7839	NC	0.1667	1.9505
Arsenic	9.5000	0.5750	0.3636	10.4386
Cadmium	0.4308	0.0183	1.0000	1.4490
Copper	0.3224	NC	0.0533	0.3757
Lead	3.7313	0.0015	0.5333	4.2661
Silver	0.0354	NC	0.0139	0.0493
Zinc	0.1108	NC	0.3227	0.4335
Total HQ	15.9144	0.5948	2.4536	18.9627
Carcinogenic Risk Summary				
Arsenic	5.08E-04	5.75E-07	8.89E-05	5.98E-04
Cadmium	NC	1.83E-08	NC	1.83E-08
Total Risk	5.08E-04	5.93E-07	8.89E-05	5.98E-04

NC - Not Calculated because no RBC provided in Smith, 1996

- antimony (2.5726), arsenic (8.3696), lead (6.1713) and manganese (4.0590) via soil ingestion, and arsenic (1.1818) via water ingestion at the Bald Butte Millsite Tailings Subarea 2;

- antimony (3.0516), arsenic (336.2739), cadmium (2.2154), iron (4.5460), lead (68.3935) and manganese (3.0429) via soil ingestion, arsenic (20.3534) via dust inhalation, and arsenic (1.1818) via water ingestion at the Bald Butte Millsite Waste Rock; and

- antimony (1.7839), arsenic (9.500) and lead (3.7313) via soil ingestion, and cadmium (1.0000) via water ingestion at the Devon/Sterling and Albion Mines Waste Rock.

HQ values greater than one indicate the potential for harmful effects by a CoC via the specified pathway. Arsenic and lead exceed the HQ values of 1 for soil ingestion at all of the project subareas evaluated for residential risk. In addition, antimony exceeds the HQ value of 1 at the Bald Butte Millsite Tailings Subarea 2 and at both of the waste rock areas and manganese exceeds the soil ingestion HQ value of 1 at the Bald Butte Millsite Tailings Subarea 2 and the Bald Butte Millsite Waste Rock. Cadmium and iron exceed HQ values of 1 at the Bald Butte Millsite waste rock.

Mercury (1.1143) and arsenic (20.3534) exceed the HQ value of 1 for dust inhalation at the Bald Butte Millsite Tailings Subarea 1 and the Bald Butte Millsite Waste Rock, respectively. Arsenic (1.1818) exceeds the HQ value of 1 for water ingestion at the Bald Butte Millsite Tailings Subareas 1 and 2 and the Bald Butte Millsite waste rock. Cadmium is equal the to the HQ value of 1 for water ingestion at the Devon/Sterling and Albion Mines waste rock.

The lower part of Tables 5-7 through 5-10 presents carcinogenic risk. Only arsenic and cadmium have carcinogenic RBCs. Arsenic and cadmium are both CoCs in the Bald Butte Millsite and Devon/Sterling and Albion Mine sites. The carcinogenic risks for arsenic in the tailings Subareas 1 and 2 are 6.66E-04 and 7.37E-04, respectively. In the Bald Butte Millsite and Devon/Sterling and Albion Waste Rock subareas, the carcinogenic risk for arsenic are 1.83E-02 and 5.98E-04, respectively. Cadmium is a CoC for all of the project subareas and the carcinogenic risk values range from 1.06E-08 to 9.39E-08. The EPA utilizes a 1.0E-06 value as a point of departure in assessing the need for contaminant cleanup at a particular site. The site values for arsenic exceed the EPA point of departure and the cadmium values do not.

5.1.4.2 Recreational Land Use Scenario

The recreational exposure assumptions utilized to estimate contaminant intakes were compared to the risk-based concentrations in Table 5-6. These data were used to calculate resultant human health carcinogenic risk values and noncarcinogenic HQs for each CoC. The results of the risk calculations for the recreational land use scenario in the Bald Butte Millsite and Devon/Sterling and Albion Mine sites are summarized in Tables 5-11 through 5-14.

Within the recreational land use scenario, only the CoC manganese at the Bald Butte Millsite Tailings Subarea 2 and the Bald Butte Millsite Waste Rock exceeded an HQ value of 1 via fish ingestion. For soil ingestion/dust inhalation, arsenic (noncarcinogenic) and lead exceeded an HQ value of 1 for rockhounds and gold panners at the Bald Butte Millsite Waste Rock. As a result, reclamation alternatives should address these exposure pathways. No HQ values exceed 1 at the Bald Butte Millsite Subarea 1 or the Devon/Sterling and Albion Mine sites.

Table 5-11 Summary of Noncarcinogenic Hazard Quotients (HQs) and Carcinogenic Risk Values for the Recreational Land Use Scenario - Bald Butte Millsite Tailings Subarea 1

Contaminant of Concern	Soil Ingestion/ Dust Inhalation for Rockhounds and Gold Panners in Waste Rock	Soil Ingestion/ Dust Inhalation for ATV and Motorcycle Riders in Tailings	Water Ingestion Rockhounds and Gold Panners in Dog Creek	Fisherman Fish Ingestion
Noncarcinogenic HQ Summary				
Antimony	NWR	0.0170	0.0123	0.0012
Arsenic	NWR	0.2847	0.0850	0.3542
Cadmium	NWR	0.0048	0.0020	0.0075
Copper	NWR	0.0087	0.0003	0.0050
Cyanide	NWR	0.0001	0.0000	0.0000
Lead	NWR	0.5255	0.0136	0.0182
Mercury	NWR	0.0106	0.0007	0.3401
Silver	NWR	NA	NA	NA
Zinc	NWR	0.0032	0.0001	0.0006
Total HQ	NWR	0.8546	0.1139	0.7268
Carcinogenic Risk Summary				
Arsenic	0.00E+00	7.47E-05	1.96E-05	8.23E-05
Cadmium	NC	3.86E-07	NC	NC
Total Risk	0.00E+00	7.50E-05	1.96E-05	8.23E-05

NC - Not Calculated because no RBC provided in Smith, 1996
NA - No risk-based recreational cleanup level for silver
NWR - No waste rock present in this Subarea

Table 5-12 Summary of Noncarcinogenic Hazard Quotients (HQs) and Carcinogenic Risk Values for the Recreational Land Use Scenario - Bald Butte Millsite Tailings Subarea 2

Contaminant of Concern	Soil Ingestion/ Dust Inhalation for Rockhounds and Gold Panners in Waste Rock	Soil Ingestion/ Dust Inhalation for ATV and Motorcycle Riders in Tailings	Water Ingestion Rockhounds and Gold Panners in Dog Creek	Fisherman Fish Ingestion
Noncarcinogenic HQ Summary				
Antimony	NWR	0.0767	0.0000	0.0000
Arsenic	NWR	0.3383	0.0850	0.3542
Cadmium	NWR	0.0031	0.0020	0.0075
Copper	NWR	0.0070	0.0003	0.0050
Lead	NWR	0.6297	0.0636	0.0848
Manganese	NWR	5.4934	0.0508	3.8576
Mercury	NWR	0.0091	0.0007	0.3401
Silver	NWR	NA	NA	NA
Zinc	NWR	0.0021	0.0001	0.0003
Total HQ	NWR	6.5595	0.2023	4.6496
Carcinogenic Risk Summary				
Arsenic	0.00E+00	8.87E-05	1.96E-05	8.23E-05
Cadmium	NC	2.51E-07	NC	NC
Total Risk	0.00E+00	8.90E-05	1.96E-05	8.23E-05

NC - Not Calculated because no RBC provided in Smith, 1996
NA - No risk-based recreational cleanup level for silver
NWR - No waste rock present in this Subarea

Table 5-13 Summary of Noncarcinogenic Hazard Quotients (HQs) and Carcinogenic Risk Values for the Recreational Land Use Scenario - Bald Butte Millsite Waste Rock

Contaminant of Concern	Soil Ingestion/ Dust Inhalation for Rockhounds and Gold Panners in Waste Rock	Soil Ingestion/ Dust Inhalation for ATV and Motorcycle Riders in Tailings	Water Ingestion Rockhounds and Gold Panners in Dog Creek	Fisherman Fish Ingestion
Noncarcinogenic HQ Summary				
Antimony	0.1614	NT	0.0123	0.0012
Arsenic	23.9452	NT	0.0850	0.3542
Cadmium	0.0494	NT	0.0020	0.0075
Copper	0.0103	NT	0.0003	0.0050
Iron	NA	NT	NA	NA
Lead	12.4352	NT	0.0136	0.0182
Manganese	0.7472	NT	0.0508	3.8576
Silver	NA	NT	NA	NA
Zinc	0.0411	NT	0.0001	0.0006
Total HQ	37.3898	NT	0.1640	4.2443
Carcinogenic Risk Summary				
Arsenic	5.56E-03	NT	1.96E-05	8.23E-05
Cadmium	NC	NT	NC	NC
Total Risk	5.56E-03	NT	1.96E-05	8.23E-05

NC - Not Calculated because no RBC provided in Smith, 1996
NA - No risk-based recreational cleanup level for iron or silver

Table 5-14 Summary of Noncarcinogenic Hazard Quotients (HQs) and Carcinogenic Risk Values for the Recreational Land Use Scenario - Devon/Sterling and Albion Mines Waste Rock

Contaminant of Concern	Soil Ingestion/ Dust Inhalation for Rockhounds and Gold Panners in Waste Rock	Soil Ingestion/ Dust Inhalation for ATV and Motorcycle Riders in Tailings	Water Ingestion Rockhounds and Gold Panners in Unnamed Tributary of Dog Creek	Fisherman Fish Ingestion
Noncarcinogenic HQ Summary				
Antimony	0.0944	NT	0.0123	0.0012
Arsenic	0.6765	NT	0.0327	0.1362
Cadmium	0.0096	NT	0.0156	0.0602
Copper	0.0184	NT	0.0003	0.0050
Lead	0.6784	NT	0.0091	0.0121
Silver	NA	NT	NA	NA
Zinc	0.0058	NT	0.0020	0.0087
Total HQ	1.4831	NT	0.0719	0.2234
Carcinogenic Risk Summary				
Arsenic	1.57E-04	NT	7.55E-06	3.16E-05
Cadmium	NC	NT	NC	NC
Total Risk	1.57E-04	NT	7.56E-06	3.16E-05

NC - Not Calculated because no RBC provided in Smith, 1996
NA - No risk-based recreational cleanup level for silver
NT - No tailings present in this Subarea

The lower part of Tables 5-11 through 5-14 presents carcinogenic risk. Only arsenic and cadmium have carcinogenic RBCs. Arsenic and cadmium are both CoCs in the Bald Butte Millsite and Devon/Sterling and Albion Mine sites. The carcinogenic risks for arsenic for soil ingestion/dust inhalation for ATV and motorcycle riders in tailings ranged from 7.47E-05 to 8.87E-05. The carcinogenic risks for arsenic for water ingestion for rockhounds and gold panners in Dog Creek in the tailings Subareas 1 and 2 are 1.96E-05. The calculated carcinogenic risk for arsenic for fisherman fish ingestion in Dog Creek is 8.23E-05.

In the waste rock project subareas, the carcinogenic arsenic soil ingestion/dust inhalation for rockhounds and gold panners ranges from 1.57E-04 to 5.56E-03. Water ingestion for rockhounds and gold panners in Dog Creek and the unnamed tributary of Dog Creek are 1.96E-05 and 7.55E-06, respectively. The arsenic carcinogenic risk for fisherman fish ingestion in Dog Creek and the unnamed tributary of Dog Creek is 8.23E-05 and 3.16E-05, respectively. The EPA utilizes a 1.0E-06 value as a point of departure in assessing the need for contaminant cleanup at a particular site. The site values for arsenic exceed the EPA point of departure value of 1.0E-06 for all recreational land use scenarios except water ingestion by rockhounds and gold panners in the unnamed tributary of Dog Creek.

Cadmium carcinogenic risk calculations were only completed for soil ingestion/dust inhalation for ATV and motorcycle riders in tailings and these results ranged from 2.51E-07 to 3.86E-07. These cadmium carcinogenic risk values do not exceed the EPA point of departure in assessing the need for contaminant cleanup.

5.2 ECOLOGICAL RISK ASSESSMENT

5.2.1 Introduction

The ecological risk assessment was performed for the Bald Butte Millsite and Devon/Sterling and Albion Mines areas following Federal RI/FS guidance for CERCLA (Superfund) sites (EPA, 1988). The key guidance documents used were EPA's Risk Assessment Guidance for Superfund, Volume II, Environmental Evaluation Manual (EPA, 1989b), and Ecological Assessment of Hazardous Waste Sites (EPA, 1989c). The waste materials present at the site pose a potential risk not only to humans, but also to other species that come into contact with them. Due to the sparse and indirect nature of the ecologic risk data available for the site, this evaluation is intended as a screening-level ecological risk assessment and the results are of a qualitative nature.

The ecological risk assessment estimates the effects of taking no action at the site and involves four steps: 1) identification of contaminants and ecologic receptors of concern; 2) exposure assessment; 3) ecologic effects assessment; and 4) risk characterization. These four tasks are accomplished by evaluating available data and selecting contaminants, species and exposure routes of concern, estimating exposure point concentrations and intakes, assessing ecologic toxicity of the CoCs, and characterizing overall risk by integrating the results of the toxicity and exposure assessments.

Problems in the Bald Butte Millsite and Devon/Sterling and Albion Mines area that could impact ecologic receptors include elevated concentrations of metals in waste materials on-site (mill tailings and waste rock piles) and elevated concentrations of metals in surface water and stream sediments downgradient from the site. The easily accessible waste materials may result in significant ecological effects; the objective of this ecological risk assessment is to estimate current and future effects of implementing the no-action alternative in the Bald Butte Millsite and Devon/Sterling and Albion Mines project areas.

5.2.2 Contaminants of Concern

As in the human health risk assessment, contaminants that are significantly above background concentrations and are associated with the site are retained as CoCs. The CoCs for the different project subareas are presented in Table 5-3. These contaminants are characteristic of hardrock mining wastes and represent contamination reliably associated with site activities. However, several of these contaminants have no ecologic toxicity data with which to evaluate potential effects.

Three groups of ecologic receptors have been identified as potentially affected by site contamination. The first group of receptors are those associated with Dog Creek (and to a lesser extent an unnamed tributary of Dog Creek) and include fisheries, aquatic life and wetlands. These surface water receptors are evaluated using USEPA aquatic life criteria, which apply to aquatic organisms only; there are no criteria with which to evaluate wetlands.

The second group of receptors are terrestrial wildlife that may use this area as part of their summer range, including deer and elk. The possibility exists for use by wildlife, both for water and for consumption of evaporative salts that can form on the wastes. This poses a potential for contaminant accumulation and subsequent health effects in the wildlife populations that visit the site. The only terrestrial wildlife receptor evaluated was deer which probably represent the highest level of exposure to site contaminants; the effects to deer can be assumed to apply to other wildlife receptors.

The third group of receptors are native terrestrial plant communities, which are noticeably absent on some of the waste sources in the Bald Butte Millsite and Devon/Sterling and Albion Mines project areas. They are of concern because the absence of vegetation enhances erosion and exposure to the wastes by potential human and wildlife receptors.

5.2.3 Exposure Assessment

The three exposure scenarios can be semi-quantitatively assessed, however, only the deer ingestion of salts and water scenario involves the calculation of a dose. Both the surface water aquatic life and plant phytotoxicity can be compared directly to existing toxicity standards that apply to environmental media.

5.2.3.1 Surface Water/Sediment - Aquatic Life Scenario

Ecologic exposures via this pathway are threefold: 1) direct exposure of aquatic organisms to surface water concentrations that exceed toxicity thresholds; 2) ingestion of aquatic species (e.g., insects) that have bioaccumulated contaminants to the extent that they are toxic to the predator (e.g., fish); and 3) exposure of aquatic organisms (e.g., fish embryos) to sediment pore water environments that are toxic due to elevated contaminant concentrations in the sediments. Sediment data used for this assessment were collected from Dog Creek and an unnamed tributary of Dog Creek during the site characterization in 2003. Water data were collected in

Dog Creek and the unnamed tributary of Dog Creek also during 2003. Selected water quality and sediment concentration data are presented in Tables 5-15 and 5-16.

TABLE 5-15 MAXIMUM CONTAMINANT CONCENTRATIONS IN SURFACE WATER

	Concentration in Surface Water (ug/L)								
Project Subarea	**Ag**	**As**	**Cd**	**Cu**	**Hg**	**Mn**	**Pb**	**Sb**	**Zn**
Bald Butte Millsite Tailings Subarea 1 (SW2)	<5	13	<1	<10	<0.2	NC	3	<5	20
Bald Butte Millsite Tailings Subarea 2 (SW4)	<5	13	<1	<10	<0.2	130	14	<5	10
Bald Butte Millsite Waste Rock (SW2)	<5	13	<1	<10	NC	130	3	<5	20
Devon/Sterling and Albion Mines Waste Rock (SW3A)	<5	5	4	<10	NC	NC	2	<5	300

Notes: NC - Not a contaminant of concern in this project subarea

TABLE 5-16 MAXIMUM CONTAMINANT CONCENTRATIONS IN STREAM SEDIMENT

	Concentration in Sediment (mg/Kg)								
Project Subarea	**Ag**	**As**	**Cd**	**Cu**	**Hg**	**Mn**	**Pb**	**Sb**	**Zn**
Bald Butte Millsite Tailings Subarea 1 (SE2)	<5	682	14	371	1.7	NC	1030	16	2430
Bald Butte Millsite Tailings Subarea 2 (SE4)	6	172	17	676	3.7	962	882	16	2590
Bald Butte Millsite Waste Rock (SE2)	<5	682	14	371	1.7	4890	1030	16	2430
Devon/Sterling and Albion Mines Waste Rock (SE3A)	<5	88	13	656	NC	NC	699	NC	2620

Notes: NC - Not a contaminant of concern in this project subarea
ND - below laboratory detection limits

5.2.3.2 Deer Ingestion Scenario

Wildlife salt uptake data provided in "Elk of North America" ranges from 1 to 11 pounds in one month for a herd of 50 to 75 elk (USDA, 1995). Using a median exposure (non-conservative) approach, the average salt usage (6 pounds/month) was divided by the average herd size (63) for an average individual salt uptake of 0.0032 pounds/day, or 0.00144 Kilograms/day (Kg/day). This intake is modified by the uptake of an additional 50% (0.00072 Kg/day) of non-salt wastes associated with the evaporative salt deposits at the site and then divided in half to account for the lower body weight of deer with respect to elk, for a total uptake of 0.0011 Kg/day. The salts are assumed to have the same concentrations as the tailings, since they are solubilized and reprecipitated from minerals in the tailings. For the purpose of this calculation, the concentration data used were the same as those presented for soil and drinking water ingestion in Table 5-4. The average deer is assumed to weigh 150 pounds (68 Kg) and consume 10 liters of water per day. The data used to estimate the total deer intake dose is summarized in Table 5-17.

TABLE 5-17 DEER INTAKE DOSE ESTIMATES

Project Subarea	As	Cd	Cu	Pb	Zn
	Water Ingestion (ug/L)				
Bald Butte Millsite Tailings Subarea 1	13	0.5	5	3	20
Bald Butte Millsite Tailings Subarea 2	13	0.5	5	14	10
Bald Butte Millsite Waste Rock	13	0.5	5	3	20
Devon/Sterling and Albion Mines Waste Rock	5	4	5	2	300
	Wastes and Salts (mg/Kg)				
Project Subarea	**As**	**Cd**	**Cu**	**Pb**	**Zn**
Bald Butte Millsite Tailings Subarea 1	162	15	844.7	2,060	2,510
Bald Butte Millsite Tailings Subarea 2	192.5	9.75	673.5	2,468.5	1,674
Bald Butte Millsite Waste Rock	7,734.3	86.4	555.9	27,357.4	18,092.7
Devon/Sterling and Albion Mines Waste Rock	218.5	16.8	999.3	1,492.5	2,547.3
Project Subarea	**Total Intake Dose (mg/Kg/day)**				
Bald Butte Millsite Tailings Subarea 1	0.0045	0.0003	0.1420	0.0332	0.0429
Bald Butte Millsite Tailings Subarea 2	0.0050	0.0002	0.0114	0.0413	0.0821
Bald Butte Millsite Waste Rock	0.1249	0.0014	0.0096	0.4354	0.2906
Devon/Sterling and Albion Mines Waste Rock	0.0042	0.0009	0.0166	0.0240	0.0846

5.2.3.3 Plant - Phytotoxicity Scenario

This scenario involves the limited ability of various plant species to grow in soil or wastes with high concentrations of site-related contaminants. Table 5-18 summarizes concentrations measured in waste materials in the Bald Butte Millsite and Devon/Sterling and Albion Mines project area during the 2003 characterization investigation.

5.2.4 Ecological Effects Assessment

The known effects of the site CoCs are available from several literature sources and are not repeated here. No site-specific toxicity tests were performed to support the ecologic risk assessment, either in-situ or at a laboratory. Only existing and proposed toxicity-based criteria and standards were used for this ecological effects assessment.

5.2.4.1 Surface Water/Sediment - Aquatic Life Scenario

Freshwater acute (1-hour average) water quality criteria have been promulgated by the EPA for many of the CoCs. Several of these criteria are calculated as a function of water hardness and a few are numerical standards. The numerical water quality standards are presented in Table 5-19 and apply to all surface waters in the Bald Butte Millsite and Devon/Sterling and Albion Mines project area. Those criteria that are a function of hardness have been calculated for each project subarea and are presented in Table 5-20. The hardness and calculated acute criteria are dependent on the sample station and sample date.

TABLE 5-18 CONTAMINANT CONCENTRATIONS IN NEAR SURFACE TAILINGS AND WASTE ROCK (mg/Kg)

Project Subarea	Ag	As	Cd	Cu	Hg	Mn	Pb	Sb	Zn	CN
Bald Butte Millsite Tailings Subarea 1	14	162	15	844.7	7.8	NC	2,060	17.7	2,510	2.2
Bald Butte Millsite Tailings Subarea 2	13.75	192.5	9.75	673.5	6.75	7,306.2	2,468.5	79.75	1,674	NC
Bald Butte Millsite Waste Rock	53.4	7,734.3	86.4	555.9	NC	5,477.3	27,357.4	94.6	18,092.7	NC
Devon/Sterling and Albion Mines Waste Rock	13.8	218.5	16.8	999.3	NC	NC	1,492.5	55.3	2,547.4	NC

Notes: NC - Not a contaminant of concern in this project subarea
Concentrations in mg/Kg as defined in Table 5-4

TABLE 5-19 NUMERIC WATER QUALITY CRITERIA

Acute Criteria (ug/l)	As	Hg	Total CN
All Project Subareas and Sample Stations	340	1.7	22

TABLE 5-20 HARDNESS-DEPENDENT WATER QUALITY CRITERIA

	Bald Butte Millsite Tailings Subarea 1			Bald Butte Millsite Tailings Subarea 2			Bald Butte Millsite Waste Rock			Devon/Sterling and Albion Mines Waste Rock		
Contaminant of Concern	Water Conc (ug/l)	Hardness (mg/l)	Acute Criteria (ug/l)	Water Conc (ug/l)	Hardness (mg/l)	Acute Criteria (ug/l)	Water Conc (ug/l)	Hardness (mg/l)	Acute Criteria (ug/l)	Water Conc (ug/l)	Hardness (mg/l)	Acute Criteria (ug/l)
Cadmium	ND			ND			ND			4	165	3.5
Copper	ND			ND			ND			ND		
Lead	3	160	148.5	14	142	127.6	3	160	148.5	2	165	154.4
Silver	ND			ND			ND			ND		
Zinc	20	160	178.4	10	142	161.3	20	160	178.4	300	165	183.1

Notes: ND - below laboratory detection limits

The EPA has not finalized sediment quality criteria. Proposed sediment criteria for metals currently consist of the Effect Range - Low (ER-L) and Effect Range - Median (ER-M) values generated from the pool of national fresh water and marine sediment toxicity information (Long and Morgan, 1991). The ER-M values are probably most appropriate to use for comparison to Dog Creek and an unnamed tributary of Dog Creek sediment data, and are presented in Table 5-21.

TABLE 5-21 SEDIMENT QUALITY CRITERIA (PROPOSED)

Criteria (mg/kg)	As	Cd	Cu	Pb	Zn
Effect Range - Median (ER-M)	85	9	390	110	270

5.2.4.2 Deer Ingestion Scenario

Adverse effects data for test animals were obtained from the Agency for Toxic Substances and Disease Registry toxicological profiles (ATSDR, 1991a, 1991b, 1991c), and from other literature sources (NAS, 1980; Maita et al, 1981). The data consist of dose (intake) levels that either cause no adverse effects (NOAELs) and/or the lowest dose observed to cause an adverse effect (LOAELs) in laboratory animals. The use of effects data for alternative species introduces an uncertainty factor to the assessment, however, effects data are not available for the species of concern (deer), so the effects data for laboratory animals (primarily rats) are adjusted only for increased body weight. These data are listed in Table 5-22.

TABLE 5-22 TOXICOLOGICAL EFFECTS LEVELS FOUND IN THE LITERATURE

Dose (mg/Kg-day)	As	Cd	Cu	Pb	Zn
LOAEL - Rat	6.4	0.014	90	0.005	571
Reference:	ATSDR, 1991a, p30	ATSDR, 1991b, p33	NAS, 1980	ATSDR, 1991c, p72	Maita et al, 1981

Note: LOAEL = Lowest observed adverse effect level.

5.2.4.3 Plant - Phytotoxicity Scenario

Information is available on the phytotoxicity for some of the CoCs (Kabata-Pendias and Pendias, 1992) and these are listed in Table 5-23. The U.S. Environmental Protection Agency (EPA) has published interim final ecological soil screening levels for some of the CoCs and others are pending (EPA, November 2003). The available EPA ecological soil screening levels for site CoCs are also presented in Table 5-23. EPA emphasizes that the soil screening levels are not appropriate to be used for cleanup levels but are values derived to avoid underestimating risk at sites. The availability of contaminants to plants and the potential for plant toxicity depends on many factors including soil pH, soil texture, nutrients, and plant species.

TABLE 5-23 SUMMARY OF SOIL CONCENTRATIONS USED FOR PHYTOTOXICITY ASSESSMENT (mg/Kg)

	Concentration Range (mg/Kg, dry wt.)							
	As	**Cd**	**Cu**	**Hg**	**Mn**	**Pb**	**Sb**	**Zn**
1	15-50	3-8	60-125	0.3-5	1500-3000	100-400	5-10	70-400
2		32				110		

Notes: 1 - Kabata-Pendias & Pendias, 1992
2 - EPA, 2003

5.2.5 Risk Characterization

This section combines the ecologic exposure estimates and concentrations presented in Section 5.2.3 and the ecologic effects data presented in Section 5.2.4 to provide a screening level estimate of potential adverse ecologic impacts for the three scenarios evaluated. This was accomplished by generating ecologic impact quotients (EQs), analogous to the health HQs calculated for human exposures to noncarcinogens. CoC-specific EQs were generated by dividing the particular intake estimate or concentration by available ecological effect values or concentrations. As with HQs, if EQs are less than one, adverse ecologic impacts are not expected.

5.2.5.1 Aquatic Life Surface Water Scenario

For this scenario, surface water concentration data are compared to acute aquatic life criteria. Limitations of this comparison are that the EPA water quality criteria are not species-specific toxicity levels. They represent toxicity to the most sensitive species, which may or may not be present in the Dog Creek drainage, and toxicity to the most sensitive species may not in itself be a limiting factor for the maintenance of a healthy, viable fishery and/or other aquatic organisms. The results of the EQ calculations for this scenario are presented in Table 5-24.

TABLE 5-24 ECOLOGIC IMPACT QUOTIENTS FOR SURFACE WATER - ACUTE AQUATIC LIFE SCENARIO

Project Subarea	Ag	As	Cd	Cu	Hg	Pb	Zn
Bald Butte Millsite Tailings Subarea 1	ND	0.0382	ND	ND	ND	0.0202	0.1121
Bald Butte Millsite Tailings Subarea 2	ND	0.0382	ND	ND	ND	0.1097	0.0620
Bald Butte Millsite Waste Rock	ND	0.0382	ND	ND	NC	0.0202	0.1121
Devon/Sterling and Albion Mines Waste Rock	ND	0.0147	1.1270	ND	NC	0.0129	1.6381

Notes: NC - Not a contaminant of concern in this project subarea
ND - below laboratory detection limits

The EQ values for each element in each project subarea are all below one with the exception of cadmium (1.1270) and zinc (1.6381) in the Devon/Sterling and Albion Mines waste rock subarea. Elements with EQ values greater than one have the potential for acute aquatic life impacts.

5.2.5.2 Aquatic Life Sediment Scenario

Stream sediment concentration data are compared to proposed sediment quality criteria using a similar method as for calculating surface water impacts. Limitations of this comparison include that these sediment quality criteria are preliminary and are also not species-specific. They represent sediment toxicity to the most sensitive species, which may or may not be present in the Dog Creek drainage area, and toxicity to the most sensitive species may not in itself be a limiting factor for the maintenance of a healthy, viable fishery and/or other aquatic organisms. The results of these EQ calculations are presented in Table 5-25. As shown in Table 5-25, there are no applicable sediment criteria for mercury. A review of the literature showed that the Oregon Department of Environmental Quality has a freshwater sediment screening level value for mercury of 0.2 mg/Kg. The screening level value is the exposure concentration deemed acceptable for ecological receptors. The Massachusetts Department of Environmental Protection has threshold effect concentrations for 28 chemicals, including mercury, for use in screening freshwater sediment for risk to benthic organisms. The threshold effect concentrations are intended to identify contaminant concentrations below which harmful effects on sediment-dwelling organisms are not expected. The threshold effect concentration for mercury is 0.18 mg/Kg. NOAA (Buchman, 1999) has developed screening quick reference tables (SQuiRTs) for both freshwater and marine sediment. The SQuiRTs data present screening levels for levels of potential effects to aquatic life from contaminated sediment. The threshold effects level (TEL) represents the concentration below which adverse effects are expected to occur only rarely, while the probable effects level (PEL) is the concentration above which adverse effects are frequently expected. Freshwater TEL and PEL values are based on benthic community metrics and toxicity test results. The TEL and PEL values for mercury are 0.174 and 0.486 mg/Kg, respectively. Thus, the Oregon, Massachusetts and NOAA sediment levels for mercury all point to a threshold value in the vicinity of 0.2 mg/Kg.

TABLE 5-25 ECOLOGIC IMPACT QUOTIENTS (EQS) FOR THE SEDIMENT - AQUATIC LIFE SCENARIO

Project Subarea	Ag	As	Cd	Cu	Hg	Pb	Zn
Bald Butte Millsite Tailings Subarea 1	NS/ND	8.0235	1.5556	0.9513	NS	9.3636	9.0000
Bald Butte Millsite Tailings Subarea 2	NS	2.0235	1.8889	1.7333	NS	8.0182	9.5926
Bald Butte Millsite Waste Rock	NS/ND	8.0235	1.5556	0.9513	NS/NC	9.3636	9.0000
Devon/Sterling and Albion Mines Waste Rock	NS/ND	1.0353	1.4444	1.6821	NS/NC/ND	6.3545	9.7037

Notes: NC - not a contaminant of concern in this project subarea
ND - below laboratory detection limits
NS - not calculated because no applicable standard exists

The EQs presented in Table 5-25 indicate the potential for aquatic life impacts (EQs greater than 1) due to apparent sediment toxicity for arsenic, cadmium, lead and zinc in Dog Creek near the Bald Butte Millsite Tailings Subarea 1 and Subarea 2 and the Bald Butte Millsite waste rock. These elements are also potentially toxic for aquatic life in the unnamed tributary of Dog Creek in the area of the Devon/Sterling and Albion Mines waste rock. The EQ for copper is greater than one for Dog Creek in the area of the Bald Butte Millsite Tailings Subarea 2 and in the unnamed tributary of Dog Creek in the area of the Devon/Sterling and Albion Mines waste rock.

Mercury was detected in one or more stream sediments collected in all of the subareas of the Dog Creek drainage. Based on a mercury threshold value for sediment of 0.2 mg/Kg, EQ values for mercury detections (1.1 to 14 mg/Kg) in the four project subareas of the Dog Creek drainage would range from 5.5 to 70. At the SQuiRTs PEL for freshwater sediment mercury of 0.486 mg/Kg, the EQ values for mercury would range from 2.3 to 28.8.

The elevated EQ's for arsenic, cadmium, lead, mercury, zinc and, to a lesser extent copper, suggest that there is a potential to adversely affect sediment benthos, fish embryos, and/or macroinvertebrate communities. However, the sediment criteria used to calculate these EQs may not apply to every species found in this system.

5.2.5.3 Deer Ingestion Scenario

Estimated deer ingestion doses were compared to the higher of the literature derived toxicological effect level (the LOAEL) and CoC-specific EQs were generated by dividing the intake estimates by the toxicological effect value. Again, the comparison is limited because of the use of effects data for alternate species, adjusted only for increased body weight and the species used for the toxicology studies may be more or less susceptible to the contaminant being studied than deer. The results of the EQ calculations for this scenario are presented in Table 5-26.

TABLE 5-26 ECOLOGIC IMPACT QUOTIENTS (EQS) FOR THE DEER INGESTION SCENARIO - LOAEL

Project Subarea	Ag	As	Cd	Cu	Hg	Pb	Zn
Bald Butte Millsite Tailings Subarea 1	NS	0.0007	0.0223	0.0002	NS	6.6391	0.0001
Bald Butte Millsite Tailings Subarea 2	NS	0.0008	0.0163	0.0001	NS	8.2617	0.0000
Bald Butte Millsite Waste Rock	NS	0.0195	0.1034	0.0001	NS/NC	87.0848	0.0005
Devon/Sterling and Albion Mines Waste Rock	NS	0.0007	0.0611	0.0002	NS/NC	4.8050	0.0001

Notes: LOAEL = Lowest observed adverse effect level.
NC - not a contaminant of concern in this project subarea
NS - not calculated because no applicable standard exists

The EQ data presented in Table 5-26 indicate the potential for adverse ecologic impacts (EQ greater than 1) to deer due to uptake of lead from the waste salts in the tailings and waste rock or from water in all of the project subareas in the Dog Creek drainage. The assumptions used to derive the uptake dose and the comparison to rat toxicity, may overestimate the actual average contaminant intake, but likely by less than an order of magnitude. It should be noted that there are no applicable standards for mercury or silver.

5.2.5.4 Plant - Phytotoxicity Scenario

Source area average concentrations collected in the Bald Butte Millsite and Devon/Sterling and Albion Mine areas are compared to high values of the range of plant phytotoxicity derived from the literature. Limitations of this comparison include that the phytotoxicity ranges are not species-specific and they represent toxicity to species which may or may not be present in the project area. Additionally, other physical characteristics of the waste materials may create microenvironments which limit growth and survival of terrestrial plants directly or in combination with substrate toxicity. Waste materials are likely to have poor water holding capacity, low organic content, limited nutrient, and may harden enough to resist root penetration. The results of the EQ calculations for this scenario are presented in Table 5-27.

TABLE 5-27 ECOLOGIC IMPACT QUOTIENTS (EQS) FOR THE PLANT - PHYTOTOXICITY SCENARIO

Project Subarea	Ag	As	Cd	Cu	Hg	Pb	Zn
Bald Butte Millsite Tailings Subarea 1	NS	3.2400	1.8750	6.7576	NS	5.1500	6.2750
Bald Butte Millsite Tailings Subarea 2	NS	3.8500	1.2188	5.3880	NS	6.1713	4.1850
Bald Butte Millsite Waste Rock	NS	154.6860	10.8000	4.4472	NS/NC	68.3935	45.2318
Devon/Sterling and Albion Mines Waste Rock	NS	4.3700	2.1000	7.9944	NS/NC	3.7313	6.3683

Notes: NC - not a contaminant of concern in this project subarea
NS - not calculated because no applicable standard exists

The EQs presented in Table 5-27 indicate the potential for adverse ecologic impacts to plant communities from arsenic, cadmium, copper, lead and zinc in all of the project subareas in the Bald Butte Millsite and Devon/Sterling and Albion Mines. The non-conservative assumption of using the high end of the phytotoxicity range to derive the EQs probably underestimates the potential phytotoxic effect to the plant community.

5.2.6 Risk Characterization Summary

The calculated EQs can be used to assess whether ecologic receptors are exposed to potentially harmful doses of site-related contaminants via the four ecologic scenarios evaluated. The EQs for each of the four scenarios are presented in Table 5-28 to estimate a combined ecologic EQ for each scenario and each contaminant. The EQ values in the table are the maximum value for the respective scenario or CoC. The results of combining the ecologic scenarios are also summarized in Table 5-28.

The EQs shown in Table 5-28 indicate that the contaminants at the site constitute probable adverse ecologic effects via the surface water, sediment, deer ingestion and plant phytotoxicity exposure scenarios. The totals by CoC for arsenic, cadmium, copper, lead and zinc resulted in EQ values greater than one in all of the project subareas. Two other CoCs, mercury and silver, did not exceed EQ values greater than one, however, no applicable standards exist for mercury or silver for evaluation of sediment, deer ingestion or plant phytotoxicity exposure scenarios. Therefore, the total EQ values for mercury and silver will be underestimated.

Specific exposure scenarios that exceed an EQ value of one include:

- Cadmium in surface water in the Devon/Sterling and Albion Mine waste rock areas;

Table 5-28 Summary of Combined Ecologic Impact Quotients for the Bald Butte Millsite and Devon/Sterling and Albion Mines Project

	Surface Water (Acute)	Sediment	Deer Ingestion	Plant Phytotoxicity	Total by CoC
Bald Butte Millsite Tailings Subarea 1					
Antimony	NS	NS	NS	NS	NS
Arsenic	0.0382	8.0235	0.0007	3.2400	11.3025
Cadmium	0.1454	1.5556	0.0223	1.8750	3.5982
Copper	0.2294	0.9513	0.0002	6.7576	7.9384
Cyanide	NS	NS	NS	NS	NS
Lead	0.0202	9.3636	6.6391	5.1500	21.1729
Mercury	0.0588	NS	NS	NS	0.0588
Silver	0.2744	NS	NS	NS	0.2744
Zinc	0.1121	9.0000	0.0001	6.2750	15.3872
TOTAL	0.8785	28.8940	6.6623	23.2976	59.7324
Bald Butte Millsite Tailings Subarea 2					
Antimony	NS	NS	NS	NS	NS
Arsenic	0.0382	2.0235	0.0008	3.8500	5.9125
Cadmium	0.1641	1.8889	0.0163	1.2188	3.2881
Copper	0.2567	1.7333	0.0001	5.3880	7.3781
Cyanide	NC/NS	NC/NS	NC/NS	NC/NS	NC/NS
Iron	NC/NS	NC/NS	NC/NS	NC/NS	NC/NS
Lead	0.1097	8.0182	8.2617	6.1713	22.5609
Manganese	NS	NS	NS	NS	NS
Mercury	0.0588	NS	NS	NS	0.0588
Silver	0.3370	NS	NS	NS	0.3370
Zinc	0.0620	9.5926	0.0000	4.1850	13.8397
TOTAL	1.0266	23.2565	8.2790	20.8130	53.3751
Bald Butte Millsite Waste Rock					
Antimony	NS	NS	NS	NS	NS
Arsenic	0.0382	8.0235	0.0195	154.6860	162.7673
Cadmium	0.1454	1.5556	0.1034	10.8000	12.6043
Copper	0.2294	0.9513	0.0001	4.4472	5.6280
Lead	0.0202	9.3636	87.08479	68.3935	164.8621
Manganese	NS	NS	NS	NS	NS
Mercury	NC	NC/NS	NC/NS	NC/NS	NC/NS
Silver	0.2744	NS	NS	NS	0.2744
Zinc	0.1121	9.0000	0.0005	45.2318	54.3443
TOTAL	0.8197	28.8940	87.2083	283.55845	400.4805
Devon/Sterling and Albion Mines Waste Rock					
Antimony	NS	NS	NS	NS	NS
Arsenic	0.0147	1.0353	0.0007	4.3700	5.4207
Cadmium	1.1270	1.4444	0.0611	2.1000	4.7326
Copper	0.2228	1.6821	0.0002	7.9944	9.8995
Lead	0.0129	6.3545	4.8050	3.7313	14.9037
Silver	0.2603	NS	NS	NS	0.2603
Zinc	1.64	9.70	0.00	6.37	17.71
TOTAL	3.28	20.22	4.87	24.56	52.93

NC - not a contaminant of concern in this project subarea
NS - not calculated because no applicable standard exists

- Arsenic, cadmium, lead and zinc in stream sediment at the Bald Butte Millsite Tailings Subarea 1, Bald Butte Millsite Tailings Subarea 2, Bald Butte Millsite waste rock area and Devon/Sterling and Albion waste rock areas;

- Copper in stream sediment at Bald Butte Millsite Tailings Subarea 2 and Devon/Sterling and Albion waste rock areas;

- Deer ingestion of lead at the Bald Butte Millsite Tailings Subarea 1, Bald Butte Millsite Tailings Subarea 2, Bald Butte Millsite waste rock area and Devon/Sterling and Albion waste rock areas; and

- Plant phytotoxicity to arsenic, cadmium, copper, lead and zinc at the Bald Butte Millsite Tailings Subarea 1, Bald Butte Millsite Tailings Subarea 2, Bald Butte Millsite waste rock area and Devon/Sterling and Albion waste rock areas;

6.0 RECLAMATION OBJECTIVES AND GOALS

The primary objective of reclamation in the Bald Butte Millsite and Devon/Sterling and Albion Mines project area is to protect human health and the environment in accordance with the guidelines set forth by the NCP. Specifically, the remedy selected must limit human and environmental exposure to the CoCs and reduce the mobility of those contaminants to reduce impacts to the local water resources.

6.1 ARAR-BASED RECLAMATION GOALS

6.1.1 Groundwater

The groundwater resources in the vicinity of the tailings and waste rock piles associated with Bald Butte Millsite and Devon/Sterling and Albion Mines project are not currently used for a drinking water source, however, a potential future use of groundwater resources is for drinking water. Although no groundwater wells are located in the area of the project waste sources, test pits constructed in and around these waste sources indicate that shallow groundwater contained in alluvium is present in many areas. Therefore, the potential for shallow groundwater impacts is considered applicable to the site. The potential contaminants of concern at the site include: antimony, arsenic, cadmium, copper, cyanide, iron, lead, manganese, mercury, silver and zinc.

ARAR-based reclamation goals are most often the maximum contaminant levels (MCLs), non-zero maximum contaminant level goals (MCLGs), or state drinking water standards, whichever are more stringent. Potential ARAR-based reclamation goals for the CoCs in the groundwater medium are presented in Table 6-1. Although groundwater is not being considered for remediation at this site, removing source material may affect groundwater metal concentrations.

TABLE 6-1 ARAR-BASED RECLAMATION GOALS FOR GROUNDWATER

Chemical	Type	Concentration, ug/L
Antimony	MCL	6
Arsenic	HHS	20
Cadmium	MCL	5
Copper	PP	1300
Total Cyanide	MCL	200
Iron	MCL	300
Lead	PP	15
Manganese	MCL	50
Mercury	MCL	2
Silver	HA	100
Zinc	HA	2000

Notes: HA - Health Advisory from EPA's "Drinking Water Standards and Health Advisories (EPA, 1996)
HHS - Human Health Standards for Groundwater Water (DEQ, 2002)
MCL - Maximum Contaminant Level Drinking Water Regulations and Health Advisories (EPA, 1993)
PP - Priority Pollutant Criteria

6.1.2 Surface Water

The results of the 2003 water quality investigation of the Dog Creek drainage basin by Olympus (DEQ-AMRB/Olympus, 2004) indicates that surface water resources near the site have been impacted by mine/mill wastes. Ore processing, infiltration of water, and erosion of tailings piles are considered primary processes which have contributed to the elevated metals observed in Dog Creek. Reclamation of the site should address the exposure risks inherent with the waste sources and provide controls which will protect water resources downstream of this area. Thus, surface water quality standards are applicable to the site.

Aquatic Life Standards and Human Health Standards are common ARARs for the surface water medium. The more stringent of the two standards is identified as the ARAR-based reclamation goal. The potential contaminants of concern at the site are: antimony, arsenic, cadmium, copper, cyanide, iron, lead, manganese, mercury, silver and zinc. The ARAR-based reclamation goals for surface water are presented in Table 6-2.

TABLE 6-2 ARAR-BASED RECLAMATION GOALS FOR SURFACE WATER

Chemical	Type	Concentration, ug/L
Antimony	HHS	6
Arsenic	HHS	18
Cadmium	CALS	0.27 @ 100 mg/L hardness
Copper	CALS	9.3 @ 100 mg/L hardness
Cyanide	CALS	5.2
Iron	MCL	300
Lead	CALS	3.2 @ 100 mg/L hardness
Manganese	MCL	50
Mercury	HHS	0.05
Silver	AALS*	4.1* @ 100 mg/L hardness
Zinc	CALS	119.8 @ 100 mg/L hardness

*Notes: *There is no chronic aquatic life standard for silver, so the acute aquatic life standard, which is more stringent than the human health standard, is presented.*
HHS - Human Health Standards for Surface Water (DEQ, 2002)
AALS - Freshwater Acute Aquatic Life Standards (DEQ, 2002)
CALS - Freshwater Chronic Aquatic Life Standards (DEQ, 2002)

6.1.3 Soil

Chemical-specific ARARs are not available at this time for the soil medium.

6.2 RISK-BASED CLEANUP GOALS

Risk-based cleanup goals have been calculated for both the carcinogenic and noncarcinogenic estimates of human health risk in the Bald Butte Millsite and Devon/Sterling and Albion Mines project area. Risk-based cleanup goals are only presented for the CoCs for which the recreational risk assessment indicated an exceedance of the hazard quotient for noncarcinogens greater than one or an exceedance of the carcinogenic risk value greater than 1E-06, and the exposure pathway was considered complete. The concentrations were derived using the risk-based cleanup guidelines for abandoned mine sites developed by the DEQ-

MWCB (Tetra Tech, 1996) and applying the exposure assumptions presented in Section 5.1.2. The risk-based goals for soil and water represent the lowest concentration for each CoC determined from the various exposure pathways considered and are presented in Table 6-3. The proposed cleanup goals attempt to reduce the risk of excess incidence of cancer to 1.0E-06 (EPA, 1990) and the noncarcinogenic health hazard quotient (HQ) to 1 (EPA, 1989a).

TABLE 6-3 RISK-BASED CLEANUP GOALS FOR THE BALD BUTTE MILLSITE AND DEVON/STERLING AND ALBION MINE AREAS ASSUMING MAXIMUM RECREATIONAL USE

Noncarcinogenic CoCs	Soil, mg/Kg	Water, ug/l
Arsenic	323[a]	36.7[b]
Lead	2,200[a]	165[b]
Manganese	1,330[c]	33.7[b]
Carcinogenic CoCs		
Arsenic	1.39[a,d]	0.158[b,d]

Notes: NA - No cleanup goal established
[a]Based on rockhound/gold panner soil ingestion/inhalation
[b]Based on fish ingestion
[c]Based on ATV/motorcycle rider soil ingestion/inhalation
[d]Based on carcinogenic risk @ 1.0E-06

7.0 DEVELOPMENT AND SCREENING OF RECLAMATION ALTERNATIVES

To facilitate the evaluation of potentially applicable reclamation technologies, the solid media at the site can be divided into three general categories based on physical and/or chemical characteristics. These categories include:

- mill tailings;
- waste rock piles; and
- mine, millsite and tailings debris.

Treatment of the solid media is dependent on the concentration of metal contaminants in the media, as well as the physical characteristics of the media. The potential applicability of a technology is dependent on the interrelationship of reclamation technologies and the volume of material requiring treatment. A brief definition of each solid media category follows.

Mill Tailings - Mill tailings are generated from the milling and beneficiation of mined ore. Mill tailings are generally composed of fine to very fine-grained sand, silt and clay. Exposed mill tailings containing sulfide minerals, especially pyrite, may develop acid rock drainage (ARD). ARD is generated by the oxidation of sulfide minerals. This process may produce acid pH conditions and increased metal solubility. Mill tailings piles which have developed ARD conditions become source areas for metal, sulfate and total dissolved solids. These potential contaminants may be mobilized during precipitation (infiltration) and stormwater runoff. Mill tailings are located in six separate piles/impoundments at the Bald Butte Millsite and in other areas along Dog Creek.

Waste Rock Piles - Waste rock piles consist of overburden, altered and/or unaltered wallrock/country rock, and below economic grade ore materials. The piles are generally located within a minimal haulage distance from the mine and contain non-mineralized and low-grade mineralized rock extracted from the mine. Waste rock piles generally contain run-of-mine muck and consist of poorly sorted rock materials ranging in size from boulders down to clay-size fractions. The nature and extent of the mineralization, climatic conditions, and natural buffering capacity of the rock pile and underlying soils determine the potential of the waste rock to generate ARD and impact water quality. Waste rock was encountered in four piles in the Bald Butte Millsite area and in three piles at the Devon/Sterling and Albion Mine sites.

Mine, Millsite and Tailings Debris - There are several old structures and debris and solid waste areas located within the Bald Butte Millsite and Devon/Sterling and Albion Mines project area. Some of these items may have historical significance. The Bald Butte Millsite area includes the remains of the Bald Butte mill foundation, a wooden pump house associated with the mill, the remains of a wooden cyanide tank agitator, four metal leaching tank cells, old cabins, a portable dragline base, numerous empty cyanide drums, a drum of suspected sodium hydroxide, remains of wooden cyanide vat tanks, remains of a wooden hopper tank, and other wood and metal debris.

7.1 IDENTIFICATION AND SCREENING OF RECLAMATION TECHNOLOGIES AND PROCESS OPTIONS

The purpose of identifying and screening technology types and processes is to eliminate those technologies and process options that are unfeasible. General response actions are refined into technology types and process options. The technology and process options are screened for reclaiming solid mine/mill waste consisting of mill tailings, waste rock and impacted soils in the Bald Butte Millsite and Devon/Sterling and Albion Mines project area. Although many remedial treatment technologies and process options have been evaluated by other workers for mine/mill solid waste, most of these are not considered feasible. These technologies involve a variety of techniques related to physical/chemical and thermal treatment processes. At the present time, most of these technologies would require extensive treatability studies, are cost prohibitive and thus not considered appropriate. Therefore, the screening process has only evaluated a limited number of treatment technologies. Table 7-1 summarizes the results of the screening process for developing reclamation alternatives for the Bald Butte Millsite and Devon/Sterling and Albion Mine sites. The following discussion summarizes each of the reclamation technologies and process options identified.

7.1.1 No Action

The no action option would require no further reclamation or monitoring actions at the site. The no action response is generally used as a baseline against which other reclamation options can be compared.

7.1.2 Institutional Controls

Land use and access restrictions are potentially applicable institutional controls for the site. Land use restrictions would limit the possible future uses of the land by employing deed restrictions in the event of property sale. Access restrictions commonly utilize fencing to control access to the site area. Land use and access restrictions may be applicable in the case of no action, capping in place, on-site disposal or any option that would leave contaminated materials on site. Such restrictions would aid in controlling future activities that may compromise a reclamation action. Institutional controls involving access restrictions via fencing and/or land use controls do not achieve a clean-up goal but are considered options which may compliment other reclamation processes.

7.1.3 Engineering Controls

Engineering controls are used to reduce the mobility of contaminants by establishing barriers that prevent contaminant exposure and migration. Engineering controls typically include containment, capping, runon/runoff controls, revegetation and/or disposal. Engineering controls generally do not reduce the volume or toxicity of the hazardous materials.

7.1.3.1 Containment

Containment technologies are used as source control measures. They are designed to eliminate direct contact and fugitive emissions from the contaminated materials. In addition, such controls are used to divert and minimize infiltration of surface water/precipitation that may contribute to erosion and/or leachate formation. The cap or cover design is a function of the degree of hazard posed by the contaminated media and may vary from a simple soil cover to a multi-layered RCRA hazardous waste cap. Specific RCRA landfill closure design criteria are put

TABLE 7-1 RECLAMATION TECHNOLOGY SCREENING SUMMARY

General Response Actions	Remedial Technology	Process Option	Description	Screening Comment
No Action	None	Not Applicable	No Action	
Institutional Controls	Access Restrictions	Fencing	Security fences installed around contaminated areas to limit access	
		Land Use Controls	Legal restrictions to control current and future land use	Potentially effective in conjunction with other technologies; Readily implementable
Engineering Controls	Containment	Wet Closure	Construct dam & flood tailings with water to limit oxidation/migration of contaminants by establishing anaerobic environment	Potentially effective if tailings consolidated and adequate water maintained during dry season; Implementable
		Soil Cover	Apply soil and establish vegetation to cover contaminant source	Surface infiltration would be reduced by evapotranspiration, but not prevented; Readily implementable
		Multi-layered RCRA Cap	Compacted clay layer covered with soil & vegetation in contaminated surface areas	Potentially effective for waste source surface isolation; surface infiltration would be significantly reduced; Readily implementable
		Asphalt or Concrete Cover	Apply asphalt or concrete over areas of exposed tailings and waste rock	Limited feasibility due to cracking over long term
	Surface Controls	Consolidation	Combining tailings, waste rock and impacted soil into single area	Potentially effective if combined with other process options; involves moving solid mine waste to single area; Readily implementable
		Grading	Level waste piles to reduce slopes for managing runoff, erosion & surface infiltration	Potentially effective if combined with other process options; Readily implementable
		Revegetation	Add amendments to waste & seed to promote vegetation for controlling water infiltration & erosion	Potentially effective in arid climates if waste does not contain high concentrations of phytotoxic elements; Readily implementable

TABLE 7-1 RECLAMATION TECHNOLOGY SCREENING SUMMARY (CONTINUED)

General Response Actions	Remedial Technology	Process Option	Description	Screening Comment
Engineering Controls (continued)		Erosion Protection/ Runon Control	Erosion resistant materials, commercial fabrics placed on tailings; stormwater diversion structures to channel water away from tailings and waste rock	Potentially effective at reducing lateral contaminant migration; Readily implementable
	On-site Disposal	RCRA Landfill	Excavated solid mine/mill waste deposited on-site in RCRA landfill	Potentially effective; Readily implementable
		Solid Waste Landfill	Excavated tailings & waste rock deposited in solid waste landfill	Potentially effective for non-hazardous materials or residues from other treatment options; Readily implementable.
	Off-site Disposal	Permitted Tailings Impoundment	Depositing tailings in permitted tailings facility	Potentially effective if facility can accept off-site tailings and is willing to do so
		RCRA Landfill	Tailings & waste rock disposed of in RCRA-C permitted facility	Potentially effective; Readily implementable
		Solid Waste Landfill	Non-hazardous mill solid wastes disposed of in non-RCRA C facility	Potentially effective for non-hazardous materials or residue from other treatment options; Readily implementable, but administratively questionable
Excavation and Treatment	Reprocessing	Milling and Smelting	Shipping tailings and waste rock to operating mill and/or smelter facility for extraction of metals	Potentially effective if economic concentrations of metals are present in wastes and an operating facility can accept off-site materials for processing and is willing to do so
	Fixation/ Stabilization	Cement/Pozzolan Additive	Tailings and waste rock are solidified with non-leachable cement or pozzolan	Extensive treatability testing and proper disposal of stabilized material would be required; Potentially implementable but cost prohibitive
In-Situ Treatment	Physical/Chemical Treatment	Stabilization	Tailings and waste rock treated in place when injected with stabilizing agent(s)	Extensive treatability testing required; Potentially implementable, but cost prohibitive

forth in 40 CFR 264.310. RCRA-designed caps may not be appropriate in instances where there is low precipitation, the toxicity of the contaminated source is relatively low, the cap is considered temporary or the waste material is not leached by infiltrating water. Future land use upon closure may also influence cap design.

Capping is an appropriate alternative when contaminated materials are to be left on site. The on-site capping option implementation is dependent on the relative toxicity of the contaminants and demonstrated impacts to human health and/or environment. Capping is also an option when excavation and disposal or treatment actions are cost prohibitive. Capping of mine/mill wastes is considered to be a standard construction practice employing accepted design methods and available equipment.

7.1.3.2 Surface Controls

Surface controls are used to minimize contaminant migration. Surface controls alone may not be appropriate in areas where direct human contact is a primary concern. In these instances, surface controls are commonly integrated with containment to provide further protection. Surface control process options are directed at controlling water and wind impacts on contaminated materials. These options include consolidation, grading, revegetation, and erosion controls.

Consolidation involves grouping wastes of similar type in a common area for more efficient management or treatment. Consolidation is important in areas where multiple smaller waste sources are present and wastes are in sensitive areas (i.e. residential or floodplain). Grading is used to reshape and compact waste areas in order to reduce slopes, manage the runon/runoff and infiltration of surface water and control erosion. Depending on the site conditions, periodic maintenance may be necessary to control subsidence and erosion problems after closure.

Revegetation involves adding soil amendments to a limited depth in the waste in order to provide nutrients and organic materials to establish vegetation. In addition, neutralizing agents and/or additives to improve pH conditions and/or the water storage capacity of the waste may be appropriate. Revegetation is essential to controlling water and wind erosion processes and minimizing infiltration of water through plant evapotranspiration processes. Revegetation generally involves the selection of appropriate plant species, preparation of the seeding area, seeding and/or planting, mulching and/or chemical stabilization and finally fertilization. Depending on the success of revegetation, the site may require maintenance in order to establish a self-sustaining plant community.

Erosion protection includes using erosion resistant materials to control water and wind impact on the contaminated media surface. Processes include surface water diversions, application of mulch and natural or synthetic fabric mats, and riprap. The erosion resistant materials are strategically placed based on a knowledge of the drainage area characteristics, slopes, vegetation types and densities, soil texture, and precipitation data.

7.3.1.3 On-Site Disposal

On-site disposal can be used as a permanent source control measure. On-site disposal may require solid waste or hazardous waste repository design or a modification of these designs. The design of the containment facility would depend on the toxicity and type of material requiring disposal. This remedial technology involves placing the untreated or treated contaminated materials in an engineered repository located in the area of the site. Design specifications could range from a simple, unlined and covered impoundment to a double-lined and double-leachate collection system repository employing a RCRA-type cap. Contaminated media failing to meet Toxicity Characteristic Leaching Procedure (TCLP) criteria may require disposal in RCRA hazardous waste-type repository and could be subject to RCRA landfill closure performance standards. Solid wastes from the beneficiation of ores and minerals, however, are not considered hazardous wastes under RCRA regulations (CFR 261.4 (b) (7)).

7.1.3.4 Off-Site Disposal

Off-site disposal involves excavating the contaminated materials and transporting them to an existing engineered repository permitted to accept such materials. Off-site disposal options may be applied to untreated or pre-treated contaminated media and would depend on the TCLP results for representative samples. Materials failing to meet TCLP criteria would require disposal in a RCRA-permitted facility. Less toxic materials could possibly be disposed of in a permitted solid waste or sanitary landfill. Solid wastes from the beneficiation of ores and minerals, however, are not considered hazardous wastes under RCRA regulations (CFR 261.4 (b) (7)).

Disposal of tailings and ore/waste rock materials in an existing permitted tailings or waste rock impoundment is considered not feasible because operating permits do not allow acceptance of off-site generated waste materials for disposal and, furthermore, mine/mill environmental managers have indicated that the environmental liability risk is not worth the endeavor. Likewise, potentially responsible parties do not want to undertake additional environmental liability by placing their waste materials at an operating mine facility that may be subject to future environmental liability.

7.1.4 Excavation and Treatment

Excavation and treatment processes involve the removal of the contaminated materials and subsequent treatment of them to reduce toxicity and/or volume. Treatment processes may involve a variety of techniques including chemical, physical or thermal methods. These methods are used to concentrate metal contaminants for additional treatment or recovery of economic constituents or to reduce the toxicity of hazardous constituents.

7.1.4.1 Reprocessing

Reprocessing involves excavation and transportation of contaminated materials to an existing mill or smelter for processing and recovery of valuable metals. Applicability of this option is dependent on the concentration of economically viable elements and the ability and willingness of the facility to process the material and dispose of the waste. Reprocessing of mine/mill wastes from outside sources is not commonly practiced due to the low concentrations of metals in source materials, operating permits limiting processing of off-site materials, and Superfund liability.

7.1.4.2 Fixation/Stabilization

Fixation/stabilization technologies employ treatment processes which chemically alter the contaminant to reduce its mobility or toxicity (fixation) or physically treat the contaminant by encapsulating with an inert material (stabilization). The technology involves mixing materials with binding agents under specific conditions to form a stable matrix. For inorganic contaminants, fixation/stabilization employs a reagent or combination of reagents to promote a chemical and/or physical change in order to reduce the mobility. Treatment processes commonly use lime, fly ash, or pozzolan/cement as additives.

7.1.5 In-Situ Treatment - Stabilization

In-situ treatment involves treating the contaminated materials in place with the objective of reducing mobility and toxicity of problem constituents. In-situ treatments provide less control than excavation and treatment options because they afford less efficient mixing of the additives. In-situ physical/chemical treatment technologies include stabilization, solidification and soil flushing. For the purpose of the Bald Butte Millsite and Devon/Sterling and Albion Mines project, only stabilization is discussed as a potential option. Stabilization has been used at some mining-related sites as a supporting reclamation technique. The process is similar to conventional stabilization in that one or more stabilizing agents are applied to the contaminated media by deep mixing techniques. At tailings sites, for example, some workers have used plowing tools which have been modified and are towed by dozers to achieve deeper mixing depths than afforded by conventional farm equipment.

7.2 IDENTIFICATION AND EVALUATION OF ALTERNATIVES

The purpose of the initial screening of alternatives is to identify those alternatives appropriate for a subsequent, detailed analysis. The initial screening also helps identify technology type, process options and specific data needs for detailed site characterization.

This section identifies potential reclamation alternatives from the reclamation technology types and associated process options that passed the initial screening effort presented in Section 7.1. Table 7-2 presents the preliminary reclamation alternatives for the Bald Butte Millsite. These retained alternatives are further screened in this section on the basis of effectiveness, implementability, and relative costs. The objective of the preliminary screening is to better define the number of reclamation alternatives that will require detailed evaluation.

Reclamation alternatives are generally screened on the basis of effectiveness, implementability, and cost. The evaluation of effectiveness includes determining the ability of an alternative to manage the contaminated media sufficiently to achieve the reclamation goals and mitigate potential future exposure. The reclamation goals include overall protection of human health and the environment, compliance with ARARs, and short- and long-term effectiveness and/or performance related to reducing toxicity, mobility, and/or volume of contaminants. The effectiveness screening criteria considers the nature and extent of contamination and site-specific conditions such as geology, hydrology, climate and land use.

TABLE 7-2 RECLAMATION ALTERNATIVES FOR THE BALD BUTTE MILLSITE

Alternative 1:	No Action
Alternative 2:	Institutional Controls
Alternative 3	Partial Consolidation/In-Place Containment
Alternative 4a	On-site Disposal in a RCRA Subtitle C Repository
Alternative 4b	On-site Disposal in a Constructed Modified RCRA Repository
Alternative 4c	On-site Disposal in a Constructed Unlined Repository With A Multi-Layered Cap
Alternative 5:	Off-site Disposal in a Permitted Solid Waste Disposal Facility
Alternative 6:	Off-site Disposal in a RCRA-Permitted Hazardous Waste Disposal Facility

The implementability of each alternative is evaluated in light of the technical and administrative feasibility of constructing, operating and maintaining the reclamation alternative. Technical feasibility considerations include the applicability of the alternative to the waste source, availability of the required equipment and expertise to implement the alternative, and overall reliability of the alternative. Implementability also considers appropriate combinations of alternatives based on site-specific conditions. Administrative feasibility evaluates logistical and scheduling constraints.

Cost screening consists of developing conservative, order-of magnitude cost estimates for each reclamation alternative based on similar sets of assumptions, i.e. volume estimates. Costs have been developed by analyzing data available from screening and implementing reclamation alternatives at similar sites. Unit costs are based on assessments of materials handling and procurement, site conditions, administrative and engineering costs, and contingency and are based on present worth values. Total costs were derived by applying estimated unit costs to assumed volumes of material to be handled or quantity of work to be performed. Where possible, cost data incorporate actual operating costs and unit costs that have been realized during similar reclamation projects. The cost estimates are directed at reclamation alternatives that are focused on the tailings piles and waste rock.

Table 7-3 presents the estimated areas and volumes of tailings and waste rock that were used in the preliminary screening. These estimated areas and volumes are based on the MDSL/AMRB Hazardous Materials Inventory (MDSL/AMRB, 1993) completed for the Bald Butte Millsite (PA# 25-179) in August 1993. The preliminary assessment did not include TP-3, TP-4, TP-5, TP-6, WR-2, WR-3 or WR-4 so no chemistry or volume data were available for these waste sources during the preliminary screening. For planning purposes, it was assumed that the chemistry of TP-3, TP-4, TP-5 and TP-6 was similar to TP-1 and TP-2 and the chemistry of WR-2, WR-3 and WR-4 was similar to WR-1. Olympus had estimated the volumes of TP-3 and TP-4 at 1,300 cubic yards and 1,000 cubic yards, respectively, and the volumes of WR-2, WR-3 and WR-4 at 1,000 cubic yards, 1,100 cubic yards and 600 cubic yards, respectively. The volumes of TP-5 and TP-6 had been estimated at 9,760 cubic yards and 4,430 cubic yards, respectively, based on information provided by Hyder (1934). These areas and volumes were used for evaluating and costing potential reclamation alternatives. The Devon/Sterling and Albion Mine waste rock piles were not considered during the preliminary screening; however, these waste sources are included in the detailed evaluation of reclamation alternatives in Section 8.

The reclamation alternatives were further screened in the following sections on the basis of effectiveness, implementability, and cost. A screening summary is presented after evaluating each alternative to identify alternatives that may be retained for further consideration and to offer rationale for exclusion of those alternatives that will no longer be considered.

TABLE 7-3 WASTE SOURCE AREAS AND VOLUMES

Source ID	Area (SF)	Area (acres)	Volume (CY)	Average Thickness (ft)
TP-1	217,800	5.00	40,300	5.0
TP-2	113,256	2.60	8,400	2.0
TP-3	7,000	0.16	1,300	5.0
TP-4	5,400	0.12	1,000	5.0
TP-5	57,675	1.32	9,760	4.6
TP-6	92,170	2.12	4,460	1.3
Total Tailings	493,301	11.32	65,220	
WR-1	2,700	0.06	850	8.5
WR-2	4,000	0.09	1,000	6.8
WR-3	3,850	0.09	1,100	7.7
WR-4	2,830	0.06	600	5.7
Total Waste Rock	13,380	0.30	3,550	
Total Waste	356,836	11.62	68,770	4.1

7.2.1 Alternative 1: No Action

The no action alternative means that no reclamation is done at the site to control contaminant migration or to reduce toxicity or volume. This option would require no further reclamation investigation or monitoring action at the site.

Effectiveness - Toxicity, mobility, and volume of contaminants would not be reduced under the no action alternative. Also, protection of human health and the environment would not be achieved under this alternative. The preliminary investigations conducted by DEQ-MWCB indicate that the Bald Butte Millsite may be causing environmental impacts to the surface water below the site. The tailings show little or no natural revegetation and tailings have potential to be eroded by wind and water. The no action alternative would not address potential surface water or groundwater impacts nor would it provide any controls on contaminant migration via direct contact or particulate emissions.

Implementability - Technical and administrative feasibility evaluation criteria do not apply to this alternative.

Cost Screening - No capital or operating costs would be incurred under this alternative.

Screening Summary - The no action response is generally used as a baseline against which other reclamation options can be compared. This alternative has been retained for further evaluation as suggested by the NCP.

7.2.2 Alternative 2: Institutional Controls

The institutional control alternative includes land use restrictions to prevent land development on or near the impacted areas and includes erecting fences to restrict access.

Effectiveness - This alternative is not practical considering the location of the tailings and waste rock piles. Controlling access would be very difficult because the site is in an unpopulated area with relatively easy and uncontrolled access. This could potentially result in vandalism to fences and unauthorized entry to the waste sources. It is not fully protective of human health and the environment if it is implemented as a stand alone option. No controls would be implemented for direct contact, stormwater runoff/infiltration, erosion or fugitive dust emissions. Toxicity, mobility, and volume of the contaminated media would not be reduced under this alternative.

Implementability - Institutional controls can be easily implemented. The alternative is applicable for controlling direct contact and restricting future inappropriate land development if the wastes are consolidated. Materials and labor are readily available. Reliability of this alternative is considered good for controlling direct contact as long as enforcement of institutional controls is maintained and deed restrictions are in place. Administrative feasibility is considered good due to the ease of implementation. This alternative, however, is not protective of the environmental resources nor is it fully protective of human health if implemented as a stand alone alternative.

Cost Screening - Table 7-4 presents the cost details associated with implementing this alternative. The total present worth cost for institutional controls is estimated at $321,542. Costs for institutional controls would be relatively low as compared to other reclamation alternatives except no action.

Screening Summary - Institutional controls will not be considered further as a stand-alone reclamation alternative but may be used in conjunction with other selected reclamation alternatives.

7.2.3 Alternative 3: Partial Consolidation/In-Place Containment

In-place containment technologies may involve establishing vegetation directly on the waste source or applying a cover over the waste source upon which the vegetation is established. Covers may range from a simple, single-layered soil cover to a complex, multi-layered cover consisting of various materials.

In most instances, cover soil must be added to tailings to establish vegetation. Texture, as opposed to phytotoxicity, is often a limiting factor when attempting to establish vegetation directly on tailings. Although most tailings are generally in the fine to very fine-grained particle size, an appreciable amount of fine silt and clay may be present. Tailings materials generally have unsuitable combinations of water holding capacity, bulk density, porosity, and infiltration properties for promoting plant growth.

Based on the absence of natural vegetation on the tailings piles, it is not likely that vegetation could be successfully established directly on TP-1, TP-2 or TP-3. Tailings piles TP-4, TP-5 and TP-6 have for the most part revegetated naturally. Erosion would be controlled by a grading plan and stormwater diversion controls. To accelerate the growth of a self-sustaining plant community, the tailings would probably require a soil cap prior to seeding and fertilization.

Table 7-4. Preliminary Cost Estimate for Alternative 2: Institutional Controls

Task	Quantity	Units	Unit $	Cost $	Comment
Mobilization, Bonding & Insurance	1	L.S.	17,280	$17,280	8%
Logistics					
Site Clearing/Preparation	1	LS	5,000	$5,000	
Perimeter Fencing	10,300	LF	20	$206,000	
Deed Restriction	1	LS	5,000	$5,000	
Subtotal				$233,280	
Construction Oversight	15%			$34,992	
Subtotal Capital Costs				$268,272	
Contingency	10%			$26,827	
TOTAL CAPITAL COSTS				$295,099	
POST CLOSURE MONITORING AND MAINTENANCE COSTS					
Inspections	1	/Year	250	$250	
Sampling & Analysis	4	/Year	200	$800	
Maintenance	1	L.S.	1500	$1,500	
Subtotal				$2,550	
Contingency	10%			$255	
TOTAL ANNUAL O&M COST				$2,805	
TOTAL CAPITAL COSTS				$295,099	
PRESENT WORTH O&M COST	30	yrs @	10%	$26,442	
TOTAL PRESENT WORTH COST				$321,542	

Vegetation of covered waste materials would further stabilize the surface, decrease water infiltration by increasing evapotranspiration, and would minimize direct contact with contaminants. The difficulty with in-place containment of the tailings is managing the on-site water, including Dog Creek, Dago Gulch and numerous springs recharging surface water.

Waste rock piles WR-1, WR-2, WR-3 and WR-4 are located on the hillside to the east of Dog Creek. In-place containment of these waste sources appears to be a viable alternative. All four waste rock piles are located out of the stream drainage, do not appear to be in the vicinity of springs and there is available space to grade, contour and cap the piles with cover soil.

Given the above considerations, the reclamation strategy for Alternative 3 involves partial consolidation and in-place containment of tailings piles TP-1, TP-2, TP-3, TP-4, TP-5 and TP-6 and in-place containment of the waste rock piles WR-1, WR-2, WR-3 and WR-4. These sources were identified in the preliminary risk analysis and in subsequent field reconnaissance as the principal sources of concern (i.e., those sources which contribute the highest relative risks for groundwater and surface water degradation). As an alternative, an organic amendment could be incorporated into the graded waste rock piles and vegetation established directly on the piles if a suitable cover soil source(s) cannot be found. Runon/runoff controls would have to be designed as an integral part of the containment strategy.

<u>Effectiveness</u> - This alternative would reduce contaminant mobility at the site by removing some of the highest risk solid media contaminant sources and consolidating and capping. However, a factor that would limit the effectiveness of this alternative is the presence of Dog Creek, which flows through the tailings piles, and numerous springs and seeps. In-place containment would not remove the tailings from contact with surface water. Establishing vegetation on the consolidated waste sources, with the application of cover soil, would reduce erosion and thereby limit contaminant mobility. Vegetation stabilizes the surface against water and wind erosion and reduces the potential for contaminant migration into groundwater. Vegetation would also aid in minimizing human and wildlife exposure to contaminants by direct contact and inhalation of dust. Careful selection of appropriate plant species that are metal tolerant, water tolerant and adapted to relatively high altitudes and relatively short growing seasons would be critical to this alternative. Although metal mobility would be minimized, full protection of groundwater would not be achieved and the toxicity and volume of the waste would not be reduced.

<u>Implementability</u> - The alternative is both technically and administratively feasible. Consolidation, grading and capping of wastes and establishment of vegetation are readily implementable using conventional construction techniques. The greatest difficulty in implementing this alternative will be water management issues. Dog Creek flows through all of the tailings piles and would need to be temporarily diverted to allow for removal and consolidation of tailings from the stream drainage. The two water ponds are likely former tailings piles and will require dewatering to remove residual tailings for consolidation. The presence of water from Dog Creek, Dago Gulch and numerous springs will make dewatering difficult.

<u>Cost Screening</u> - The total present worth cost for Alternative 3: Partial Consolidation/In-Place Containment is estimated at $1,269,741. Table 7-5 presents the cost details associated with implementing this alternative. The total cost includes the present-worth value of 30 years of annual maintenance and monitoring costs in addition to capital/construction costs.

Table 7-5. Preliminary Cost Estimate for Alternative 3: Partial Consolidation/In-Place Containment

Task	Quantity	Units	Unit $	Cost $	Comment
Mobilization, Bonding & Insurance	1	L.S.	71,722	$71,722	8%
Logistics					
Access Road	7300	LF	2.00	$14,600	
Site Clearing/Preparation	13.64	Ac	2,000	$27,280	
Dog Creek Stream Diversion	3,700	LF	25.00	$92,500	
Dewater Ponds	1	LS	10,000	$10,000	
Debris Removal and Onsite Disposal	1	LS	10,000	$10,000	
In-Place Containment					
Consolidate Tailings	32,610	CY	4.00	$130,440	
Grade Consolidated Tailings	32,610	CY	2.00	$65,220	
Grade Waste Rock Piles	1,775	CY	4.00	$7,100	
Tailings Riprap Protection	2,741	CY	25.00	$68,525	
Cover Soil	14,818	CY	6.00	$88,908	
Stream Channel Reconstruction	4,200	LF	80.00	$336,000	
Water Diversion/Runon Controls					
Run-on Control Ditch	3,600	LF	2.00	$7,200	
Revegetation					
Seed/Fertilize	13.80	Ac	1,000	$13,800	
Mulch	13.80	Ac	1,000	$13,800	
Fencing					
Barbed-wire Fence	10,300	LF	2.50	$25,750	
Subtotal				$982,845	
Construction Oversight	15%			$147,427	
Subtotal Capital Costs				$1,130,272	
Contingency	10%			$113,027	
TOTAL CAPITAL COSTS				$1,243,299	
POST CLOSURE MONITORING AND MAINTENANCE COSTS					
Inspections	1	/Year	250	$250	
Sampling & Analysis	4	/Year	200	$800	
Maintenance	1	L.S.	1500	$1,500	
Subtotal				$2,550	
Contingency	10%			$255	
TOTAL ANNUAL O&M COST				$2,805	
TOTAL CAPITAL COSTS				$1,243,299	
PRESENT WORTH O&M COST	30	yrs @	10%	$26,442	
TOTAL PRESENT WORTH COST				$1,269,741	

Conceptual Design and Assumptions

Each waste rock pile will be graded in place to reduce the slopes and capped with cover soil. It is assumed that the grading will require moving one half of the volume of each waste rock pile to achieve the desired slopes. The grading is assumed to increase the plan area of each waste rock pile by 50 percent.

The following assumptions were used to estimate the costs associated with this alternative:

- Requires approximately 7,300 feet of single-lane access road improvements with turnouts.
- Consolidation and grading of the tailings will require the removal of one half of the volume of TP-1, TP-2, TP-3, TP-4, TP-5 and TP-6, which is equivalent to 32,610 cy.
- Approximately 2,741 cubic yards of riprap will be used to protect the toe of the consolidated tailings piles from erosion by Dog Creek.
- Grading of the waste rock piles will require the excavation of one half of the volume of WR-1, WR-2, WR-3 and WR-4, which is equivalent to 1,775 cy.
- Grading of each waste rock pile will increase the plan area by 50 percent.
- The total length of Dog Creek stream reconstruction is 4,200 lineal feet.
- A 1.5-feet-thick layer of cover soil (14,818 cubic yards) would overlay the consolidated and graded tailings and waste rock piles. A suitable source of vegetative cover soil must be identified.
- Conventional plowing techniques would be adequate for preparing seed beds in the excavated source areas.
- The total surface area at the site requiring revegetation is approximately 13.80 acres (which includes the excavated source areas, consolidation tailings areas, graded waste rock piles, and haul roads).
- The total length of required runon/runoff control diversion ditch in the waste consolidation area is approximately 3,600 lineal feet.
- A total of 10,300 lineal feet of 4-strand, barbed-wire fence will be constructed around the perimeter of the reclaimed areas.

Screening Summary

This alternative has been retained for detailed analysis since in-place containment may be a feasible and cost-effective remedy for the site since enough space appears to be available for consolidating and sloping the wastes and achieving an overall acceptable grading plan after the tailings and waste rock are consolidated. Diversion of Dog Creek and dewatering of the two water ponds and the tailings piles are critical to this alternative.

7.2.4 Alternative 4: On-Site Disposal in a Constructed Repository

Three separate reclamation scenarios have been evaluated under Alternative 4. The major differences between the three scenarios have to do with the design of the liner system which would underlay the encapsulated wastes. The three scenarios considered include: 1) construction of a repository which complies with all RCRA Subtitle C regulations for hazardous waste landfill closures (this scenario includes a double-liner system with integral primary and secondary leachate collection and removal systems) and a multi-layered cap; 2) construction of a modified RCRA repository which includes a single composite liner without a leachate collection and removal system, also with a multi-layered cap; and 3) construction of an unlined repository with a multi-layered cap. Design and construction costs associated with the three scenarios will vary according to the relative degree of protection provided by the liner system (i.e., the higher the relative degree of protection provided by the liner system, the higher the associated costs). Two of the above scenarios (scenarios 2 and 3) do not comply with EPA's Minimum Technology Guidance for hazardous waste landfill closures. However, the scenarios may still provide adequate environmental protection considering the chemical and physical characteristics of the Bald Butte Millsite wastes, in conjunction with the physical location of the proposed repository site and the area's generally semi-arid climate. Each repository design scenario will be individually evaluated (if the reclamation alternatives are analyzed in detail) using the Hydrologic Evaluation Landfill Performance (HELP) Model, developed by the EPA (1997), to determine the relative effectiveness of each design and ultimately conclude which design is most appropriate considering the anticipated expenditure (i.e., which design is most cost-effective).

The following conceptual design applies to Alternatives 4a, 4b and 4c. The sources to be disposed of in the repository include the six tailings piles and the four waste rock piles. A potential repository area is located north of the tailings areas near the hillside on the east side of the drainage. Based on a field reconnaissance, this area is away from the stream and should be isolated from the springs observed at the site. To accommodate the wastes, the repository would require a footprint of approximately 300 feet by 485 feet (3.34 acres) and be 21 feet thick with 4:1 side slopes. The repository lining and capping configuration differ among the three alternatives. A considerable amount of heavy equipment/machinery would be necessary to efficiently implement these alternatives. To construct the repository and load out the waste material, as well as construct runon/runoff control structures, equipment requirements would include, but not be limited to, multiple bulldozers, front end loaders and excavators. Haul trucks or scrapers would also be required to transport and deposit the contaminated material in the constructed repository. The field procedure would involve improving the existing road along the east side of the site from TP-6 to the repository area to a one lane haul road with turnouts to allow unobstructed access for heavy equipment. The number of loaders, haul trucks and/or scrapers would be maximized to the extent possible to reduce the overall time required to complete the project's construction phase.

Removal of the tailings would require the construction of a temporary diversion of Dog Creek while excavating the tailings. Dog Creek could be intercepted north of the two water ponds and diverted to the east of the TP-1 and TP-2. Dog Creek would also need to be diverted around TP-3, TP-4, TP-5 and TP-6. Dog Creek would be reconstructed in the vicinity of each tailings pile after the tailings are removed. After the repository construction, waste excavation, and waste placement are complete, the excavated areas would be revegetated. Cover/fill soil may be required in the excavated areas to level and contour the areas to match the surrounding terrain. The seed beds would be prepared using conventional agricultural plowing. Seeding would likely take place during the fall of the year. The seed mixture and fertilizer would be applied simultaneously to the prepared seed beds via drill application. Mulch would be applied to promote temporary protection of exposed erodible surfaces. Wheat or barley straw mulch (certified weed-free) would be applied over the excavated areas and the repository cap with a tow spreader or pneumatic spreader utilizing tucking/crimping as the anchoring mechanism. A runon/runoff control ditch would be constructed in the area of the repository to divert runoff away from the repository cap. Barbed-wire fencing would be placed around the excavated waste source areas to allow the establishment of vegetation without interference from livestock. A woven-wire fence would be constructed around the repository to limit access.

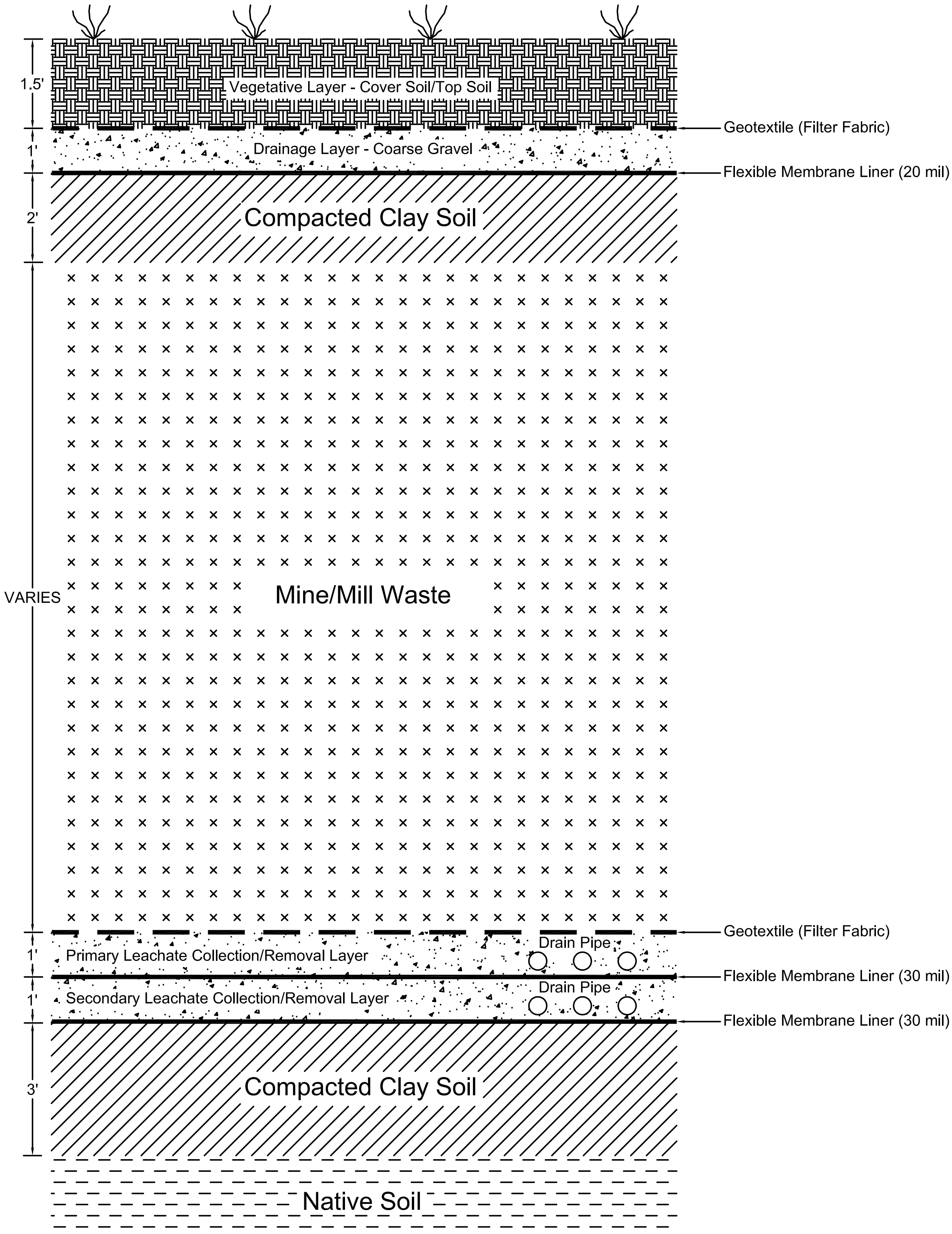
7.2.4.1 Alternative 4a: On-Site Disposal in a Constructed RCRA Subtitle C Repository

The reclamation strategy for Alternative 4a involves removing all identified waste sources at the Bald Butte Millsite and disposing these wastes in a constructed repository which complies with all RCRA Subtitle C regulations for hazardous waste landfill closures (Figure 7-1). The repository would consist of a composite, double-lined leachate collection and removal system underlying the waste in conjunction with a composite, multi-layered, lined cap overlying the waste.

The potential repository area has been logged and has abundant tree stumps that would require removal prior to repository construction. After the repository area has been cleared and prepared, a bottom liner and leachate collection system would be installed. Once the waste sources are placed in the repository, a multi-layered cap would be constructed overlying the waste, and the repository cap would be revegetated. Because of the steep topography surrounding the site and rock outcrops observed in the repository area, it is assumed that bedrock is shallow and there is no significant soil to be recovered from the repository base to use for capping materials. Shallow bedrock, if exposed, could also pose problems for the liner installation. Shallow bedrock can potentially damage liner materials when the repository is loaded with waste material. A runon/runoff control ditch would be constructed in the area of the repository to divert surface water away from the repository cap.

<u>Effectiveness</u> - This alternative would effectively reduce contaminant mobility at the site by removing the highest risk solid media contaminant sources and disposing of the waste in a secure disposal facility. Consequently, the surface water and wind erosion problems associated with the site are expected to be mitigated. Contaminant toxicity and volume would not be reduced, however, the waste would be rendered immobile in a structure and physical location protected from erosion problems. Long-term monitoring and control programs would be established to ensure continued effectiveness.

<u>Implementability</u> - This alternative is both technically and administratively feasible. The construction steps required are considered conventional construction practices. Key project components, such as the availability of equipment, materials, and construction expertise, are all present and would help ensure the timely implementation and successful execution of the proposed plan. The greatest difficulty in implementing this alternative will be water management issues. Dog Creek flows through all of the tailings piles and would need to be temporarily diverted to allow for tailings removal. The two water ponds are likely former tailings piles and will require dewatering to remove residual tailings. The presence of water from Dog Creek, Dago Gulch and numerous springs will make dewatering difficult.



Olympus Technical Services, Inc.

ALTERNATIVES 4A - ONSITE DISPOSAL IN A RCRA SUBTITLE C REPOSITORY

FIGURE 7-1

Drawn: KSR	Checked: CRS	Date: 4/2003	Job No: A138
Design:	Approved:	Scale: NONE	File: A1348-567A.dwg

MONTANA DEQ/MINE WASTE CLEANUP BUREAU
BALD BUTTE MILLSITE
LEWIS & CLARK COUNTY, MONTANA

Cost Screening - The total present-worth cost for this alternative has been estimated at \$2,487,721 which represents the reclamation of all the tailings and waste rock piles present at the Bald Butte Millsite. Table 7-6 presents the cost details associated with implementing this alternative. The total cost includes the present-worth value of 30 years of annual maintenance and monitoring costs in addition to capital costs. The cost estimate assumes that a geotextile cushion and geosynthetic clay liner (GCL) are used rather than compacted clay soil and geocomposite drainage layers are used for the leachate collection system rather than gravel and drain pipes.

The following assumptions were used to estimate the costs associated with this alternative:

- Requires approximately 7,300 feet of single-lane access road improvement with turnouts.

- The total volume of waste material to be excavated and disposed of in the repository is 68,770 cy.

- Because of probable shallow bedrock, there will be no initial excavation for constructing the repository. All earth materials used in the base liner and cap system will need to be found elsewhere on the site or imported from offsite.

- Bottom Liner - Based on the geologic setting and evidence of rock outcrops in the vicinity of the repository area, the native soil in the repository area is probably a thin layer consisting of coalluvial material derived from the adjacent steep slope. This material is assumed to be unsuitable for achieving the desired hydraulic conductivity barrier layer ($\leq 1 \times 10^{-7}$ cm/sec). Therefore, clay material would need to be imported, blended, and compacted with the native soil to provide the desired properties. This compacted base layer would be 3 feet deep, and soil lifts would be applied and compacted in 6-inch intervals. If the native soil is not capable of providing the desired, low hydraulic conductivity, a GCL could be used in lieu of a three-feet-thick, compacted liner. The cost screening above assumes that sufficient native clay material is not available on site or near the site and a GCL is used for the base liner. A 30-mil-thick, HDPE flexible membrane liner would overlay the compacted base or GCL. A geotextile cushion layer would be placed under the GCL to protect it from being damaged.

- Secondary Leachate Collection/Removal Layer - A one-foot-thick layer of washed, coarse gravel would overlay the bottom liner. PVC drain pipes would be installed in conjunction with the coarse gravel layer for leachate collection/removal. A 30-mil thick, HDPE flexible membrane liner would overlay the secondary coarse gravel layer. If a sufficient source of washed, coarse gravel is not available on site or near the site, a geocomposite drainage layer could be used in lieu of a one-foot-thick washed gravel layer and PVC drain pipes. The cost screening above assumes that a geocomposite drainage layer is used for the secondary leachate collection system. A cost/benefit analysis would be performed during the detailed evaluation of reclamation alternatives to determine the most cost-effective drainage layer design (granular drainage vs. geocomposite).

- Primary Leachate Collection/Removal Layer - A one-foot-thick layer of washed, coarse gravel would overlay the secondary leachate collection/removal layer. PVC drain pipes would be installed in conjunction with the coarse gravel layer for leachate collection/removal. A geotextile filter fabric layer (to prevent potential clogging of the coarse gravel) would overlay the primary coarse gravel layer. If a sufficient source of washed, course gravel is not available on site or near the site, a geocomposite drainage layer could be used in lieu of

Table 7-6. Preliminary Cost Estimate for Alternative 4a: On-Site Disposal in a Constructed RCRA Subtitle C Repository

Task	Quantity	Units	Unit $	Cost $	Comment
Mobilization, Bonding & Insurance	1	L.S.	144,124	$144,124	8%
Logistics					
Access Road	7,300	LF	2.00	$14,600	
Site Clearing/Preparation	14.97	Ac	2,000	$29,940	
Dog Creek Stream Diversion	3,700	LF	25.00	$92,500	
Dewater Ponds	1	LS	10,000	$10,000	
Debris Removal and Onsite Disposal	1	LS	10,000	$10,000	
Repository Construction					
Repository Base Grading	3.34	Ac	2,000	$6,680	
Install Geotextile Cushion	16,167	SY	3.00	$48,501	
Geosynthetic Clay Liner	16,167	SY	4.50	$72,752	
30 mil HDPE Liner	16,167	SY	6.00	$97,002	
Geocomposite Drainage Layer	16,167	SY	4.50	$72,752	
30 mil HDPE Liner	16,167	SY	6.00	$97,002	
Geocomposite Drainage Layer	16,167	SY	4.50	$72,752	
Leachate Collection/Removal System	1	LS	10,000	$10,000	
Waste Load, Haul & Dump					
Tailings	65,220	CY	4.00	$260,880	
Waste Rock	3,550	CY	4.00	$14,200	
Waste Grading and Compaction	68,770	CY	2.00	$137,540	
Cap Construction					
Install Geotextile Cushion	16,521	SY	3.00	$49,563	
Geosynthetic Clay Liner	16,521	SY	4.50	$74,345	
Install Cap Liner (20 mil HDPE)	16,521	SY	5.00	$82,605	
Geocomposite Drainage Layer	16,521	SY	4.50	$74,345	
Cover Soil	11,014	CY	6.00	$66,084	
Stream Channel Reconstruction	4,200	LF	80.00	$336,000	
Water Diversion/Runon Controls					
Run-on Control Ditch	1,100	LF	2.00	$2,200	
Revegetation					
Seed/Fertilize	16.98	Ac	1,000	$16,980	
Mulch	16.98	Ac	1,000	$16,980	
Fencing					
Barbed-wire Fence	10,300	LF	2.50	$25,750	
Repository Fence	1,600	LF	6.00	$9,600	
Subtotal				$1,945,675	
Construction Oversight	15%			$291,851	
Subtotal Capital Costs				$2,237,526	
Contingency	10%			$223,753	
TOTAL CAPITAL COSTS				$2,461,278	
POST CLOSURE MONITORING AND MAINTENANCE COSTS					
Inspections	1	/Year	250	$250	
Sampling & Analysis	4	/Year	200	$800	
Maintenance	1	L.S.	1500	$1,500	
Subtotal				$2,550	
Contingency	10%			$255	
TOTAL ANNUAL O&M COST				$2,805	
TOTAL CAPITAL COSTS				$2,461,278	
PRESENT WORTH O&M COST	30	yrs @	10%	$26,442	
TOTAL PRESENT WORTH COST				$2,487,721	

a one-foot-thick washed gravel layer, PVC drain pipes and geotextile filter fabric layer. The cost screening above assumes that a geocomposite drainage layer is used in the primary leachate collection system. A cost/benefit analysis would be performed during the detailed evaluation of reclamation alternatives to determine the most cost-effective drainage layer design (granular drainage vs. geocomposite).

- The mine wastes would be deposited over the primary leachate collection system at an average depth of approximately 12.1 feet and a maximum thickness of 21 feet.

- Cap Liner - The native soil in the area of the repository is not expected to be adequate to provide the desired, low hydraulic conductivity barrier layer ($\leq 1 \times 10^{-7}$ cm/sec). Clay material could be imported, blended, and compacted with the native soil to provide the desired properties. This compacted layer would be 2 feet thick, and soil lifts would be applied and compacted in 6-inch intervals. If the native soil is not capable of providing the desired, low hydraulic conductivity, a GCL could be used in lieu of a two-feet-thick, compacted liner. The cost screening above assumes that a GCL is used in the cap liner system. A geotextile cushion layer would be placed beneath the GCL to protect it from being damaged. A cost/benefit analysis would be performed during the detailed evaluation of reclamation alternatives to determine the most cost-effective low-permeability liner system (compacted clay vs. GCL). A 20-mil-thick, HDPE flexible membrane liner would overlay the compacted soil layer or GCL.

- Drainage Layer - A one-foot-thick layer of washed, coarse gravel would overlay the compacted soil layer. A geotextile filter fabric layer (to prevent potential clogging of the coarse gravel) would overlay the coarse gravel drainage layer. If a sufficient source of washed, course gravel is not available on site or near the site, a geocomposite drainage layer could be used in lieu of a one-foot-thick washed gravel layer and filter fabric in the cap system. The cost screening above assumes that a geocomposite drainage layer is used in the cap liner system. A cost/benefit analysis would be performed during the detailed evaluation of reclamation alternatives to determine the most cost-effective cap drainage layer design (granular drainage vs. geocomposite).

- Vegetative Cover - A two-feet-thick layer of native soil would overlay the cap drainage layer. Cover soil sources will need to be identified during detailed site characterization.

- The total length of Dog Creek stream reconstruction is 4,200 lineal feet.

- The surface area for grading and contouring of excavated source areas is 11.62 acres.

- Conventional plowing techniques would be adequate for preparing seed beds in the excavated source areas.

- The total surface area at the site requiring revegetation is approximately 16.98 acres (which includes the excavated source areas, repository cap and haul roads).

- The total length of required runon/runoff control diversion ditches is approximately 1,100 lineal feet.

- A total of 10,300 lineal feet of 4-strand, barbed-wire fence and 1,600 lineal feet of repository fence will be constructed around the perimeter of the reclaimed areas.

Screening Summary

This alternative has been retained for detailed analysis because it provides the highest level of protection of the on-site disposal options.

7.2.4.2 Alternative 4b: On-site Disposal in a Constructed Modified RCRA Repository

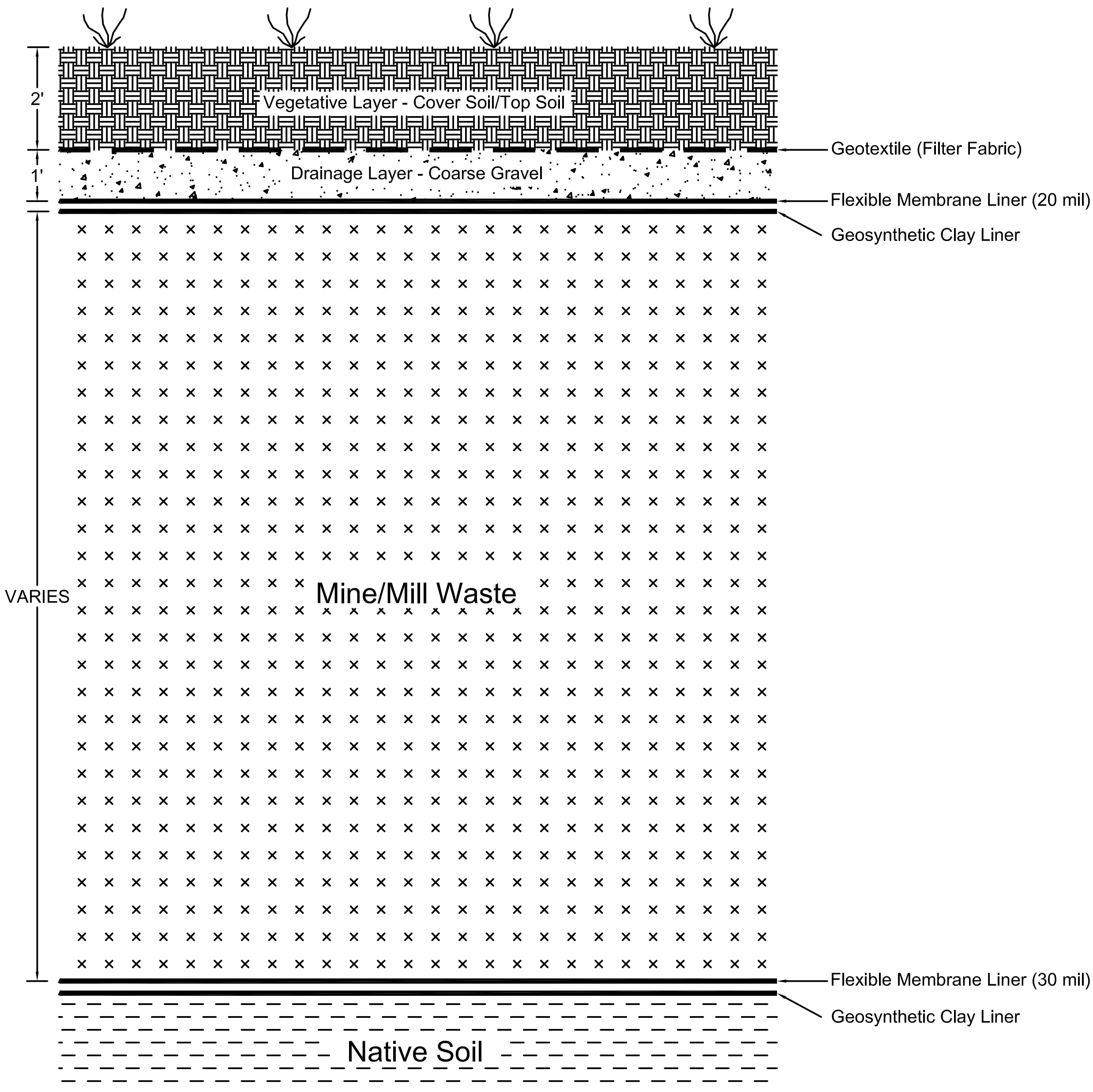
The reclamation strategy for Alternative 4b involves removing all identified waste sources at the Bald Butte Millsite and disposing these wastes in a constructed modified RCRA repository which includes a single composite liner (without a leachate collection and removal system) and a multi-layered cap (Figure 7-2).

The potential repository area has been logged and has abundant tree stumps that would require removal prior to repository construction. After the repository area has been cleared and prepared, the bottom liner system would be installed. Once the waste sources are placed in the repository, a multi-layered cap would be constructed overlying the waste, and the repository cap would be revegetated. Because of the steep topography surrounding the site and rock outcrops observed in the repository area, it is assumed that bedrock is shallow and there is no significant soil to be recovered from the repository base to use for capping materials. Shallow bedrock, if exposed, could also pose problems for the liner installation. Shallow bedrock can potentially damage liner materials when the repository is loaded with waste material. A runon/runoff control ditch would be constructed in the area of the repository to divert surface water away from the repository cap.

Effectiveness - This alternative would effectively reduce contaminant mobility at the site by removing the highest risk solid media contaminant sources and disposing of the waste in a secure disposal facility. Consequently, the surface water erosion problems associated with the site are expected to be mitigated. Contaminant toxicity and volume would not be reduced, however, the waste would be rendered immobile in a structure and physical location protected from erosion problems. Infiltration of precipitation through the waste sources and resulting migration of contaminants through the vadose zone and groundwater would also be significantly reduced. Long-term monitoring and control programs would be established to ensure continued effectiveness.

This alternative is not expected to provide as high a degree of effectiveness as provided by a constructed repository which complies with all RCRA Subtitle C regulations (Alternative 4a), however, this alternative may provide adequate protection at a significantly reduced cost. Although this alternative does not comply with EPA's Minimum Technology Guidance (EPA, 1989d), the design may provide adequate environmental protection considering the chemical and physical characteristics of the mine waste in conjunction with the physical location of the repository site and the area's generally semi-arid climate. EPA's HELP Model could be applied to the conceptual design to determine the relative effectiveness of the design and ultimately to determine the overall feasibility of the alternative and associated cost effectiveness.

Implementability - This alternative is both technically and administratively feasible. The construction steps required are considered conventional construction practices. Key project components, such as the availability of equipment, materials, and construction expertise, are all present and would help ensure the timely implementation and successful execution of the proposed plan. The greatest difficulty in implementing this alternative will be water



Olympus Technical Services, Inc.				ALTERNATIVES 4B - ONSITE DISPOSAL IN A MODIFIED RCRA REPOSITORY / MONTANA DEQ/MINE WASTE CLEANUP BUREAU BALD BUTTE MILLSITE LEWIS & CLARK COUNTY, MONTANA
Drawn: KSR	Checked: CRS	Date: 4/2003	Job No: A1348	FIGURE 7-2
Design:	Approved:	Scale: NONE	File: A1348-567B.dwg	

management issues. Dog Creek flows through all of the tailings piles and would need to be temporarily diverted to allow for tailings removal. The two water ponds are likely former tailings piles and will require dewatering to remove residual tailings. The presence of Dog Creek, Dago Gulch and numerous springs will make dewatering difficult.

Cost Screening - The total present-worth cost for this alternative has been estimated at $2,175,880 which represents the reclamation of all the tailings and waste rock piles present at the Bald Butte Millsite. Table 7-7 presents the cost details associated with implementing this alternative. The total cost includes the present-worth value of 30 years of annual maintenance and monitoring costs in addition to capital costs. The cost estimate assumes that a geocomposite drainage layer is used in the cap liner system rather than a washed coarse gravel.

The following assumptions were used to develop costs for this alternative:

- Requires approximately 7,300 feet of single-lane access road improvement with turnouts.
- The total volume of waste material to be excavated and disposed of in the repository is 68,770 cy.
- Because of probable shallow bedrock, there will be no initial excavation for constructing the repository. All earth materials used in the base liner and cap system will need to be found elsewhere on the site or imported from offsite.
- Bottom Liner - A GCL would be installed in the repository base. A 30-mil-thick, HDPE flexible membrane liner would overlay the GCL.
- The mine wastes would be deposited over the flexible membrane liner at an average depth of approximately 12.1 feet and a maximum thickness of 21 feet.
- Cap Liner - A GCL would be installed overlaying the mine waste. A 20-mil-thick, HDPE flexible membrane liner would overlay the GCL.
- Drainage Layer - A one-foot-thick layer of washed, coarse gravel would overlay the composite cap liner system. A geotextile filter fabric layer (to prevent potential clogging of the coarse gravel) would overlay the coarse gravel drainage layer. If a sufficient source of washed, coarse gravel is not available on site or near the site, a geocomposite drainage layer could be used in lieu of a one-foot-thick washed gravel layer in the cap system. The cost screening above assumes that a geocomposite drainage layer is used in the cap liner system. A cost/benefit analysis would be performed during the detailed evaluation of reclamation alternatives to determine the most cost-effective cap drainage layer design (granular drainage vs. geocomposite).
- Vegetative Cover - A two-feet-thick layer of native soil would overlay the cap drainage layer. Cover soil sources will need to be identified during detailed site characterization.
- The total length of Dog Creek stream reconstruction is 4,200 lineal feet.
- The surface area for grading and contouring of excavated source areas is 11.62 acres.

Table 7-7. Preliminary Cost Estimate for Alternative 4b: On-Site Disposal in a Constructed Modified RCRA Repository

Task	Quantity	Units	Unit $	Cost $	Comment
Mobilization, Bonding & Insurance	1	L.S.	125,864	$125,864	8%
Logistics					
Access Road	7,300	LF	2.00	$14,600	
Site Clearing/Preparation	14.97	Ac	2,000	$29,940	
Dog Creek Stream Diversion	3,700	LF	25.00	$92,500	
Dewater Ponds	1	LS	10,000	$10,000	
Debris Removal and Onsite Disposal	1	LS	10,000	$10,000	
Repository Construction					
Repository Base Grading	3.34	Ac	2,000	$6,680	
Install Geosynthetic Clay Liner	16,167	SY	4.50	$72,752	
Install Geosynthetic Clay Liner	16,167	SY	4.50	$72,752	
Install 30 mil Flexible Membrane Liner	16,167	SY	6.00	$97,002	
Waste Load, Haul & Dump					
Tailings	65,220	CY	4.00	$260,880	
Waste Rock	3,550	CY	4.00	$14,200	
Waste Grading and Compaction	68,770	CY	2.00	$137,540	
Cap Construction					
Install Geotextile Cushion	16,521	SY	3.00	$49,563	
Install Geosynthetic Clay Liner	16,521	SY	4.50	$74,345	
Install Cap Liner (20 mil HDPE)	16,521	SY	5.00	$82,605	
Geocomposite Drainage Layer	16,521	SY	4.50	$74,345	
Cover Soil	11,014	CY	6.00	$66,084	
Stream Channel Reconstruction	4,200	LF	80.00	$336,000	
Water Diversion/Runon Controls					
Run-on Control Ditch	1,100	LF	2.00	$2,200	
Revegetation					
Seed/Fertilize	16.98	Ac	1,000	$16,980	
Mulch	16.98	Ac	1,000	$16,980	
Fencing					
Barbed-wire Fence	10,300	LF	2.50	$25,750	
Repository Fence	1,600	LF	6.00	$9,600	
Subtotal				$1,699,160	
Construction Oversight	15%			$254,874	
Subtotal Capital Costs				$1,954,034	
Contingency	10%			$195,403	
TOTAL CAPITAL COSTS				$2,149,437	
POST CLOSURE MONITORING AND MAINTENANCE COSTS					
Inspections	1	/Year	250	$250	
Sampling & Analysis	4	/Year	200	$800	
Maintenance	1	L.S.	1500	$1,500	
Subtotal				$2,550	
Contingency	10%			$255	
TOTAL ANNUAL O&M COST				$2,805	
TOTAL CAPITAL COSTS				$2,149,437	
PRESENT WORTH O&M COST	30	yrs @	10%	$26,442	
TOTAL PRESENT WORTH COST				$2,175,880	

- Conventional plowing techniques would be adequate for preparing seed beds in the excavated source areas.

- The total surface area at the site requiring revegetation is approximately 16.98 acres (which includes the excavated source areas, repository cap and haul roads).

- The total length of required runon/runoff control diversion ditches is approximately 1,100 lineal feet.

- A total of 10,300 lineal feet of 4-strand, barbed-wire fence and 1,600 lineal feet of repository fence will be constructed around the perimeter of the reclaimed areas.

Screening Summary

This alternative has been retained for detailed analysis since it is the most cost-effective alternative that provides for total encapsulation of the waste in an on-site repository.

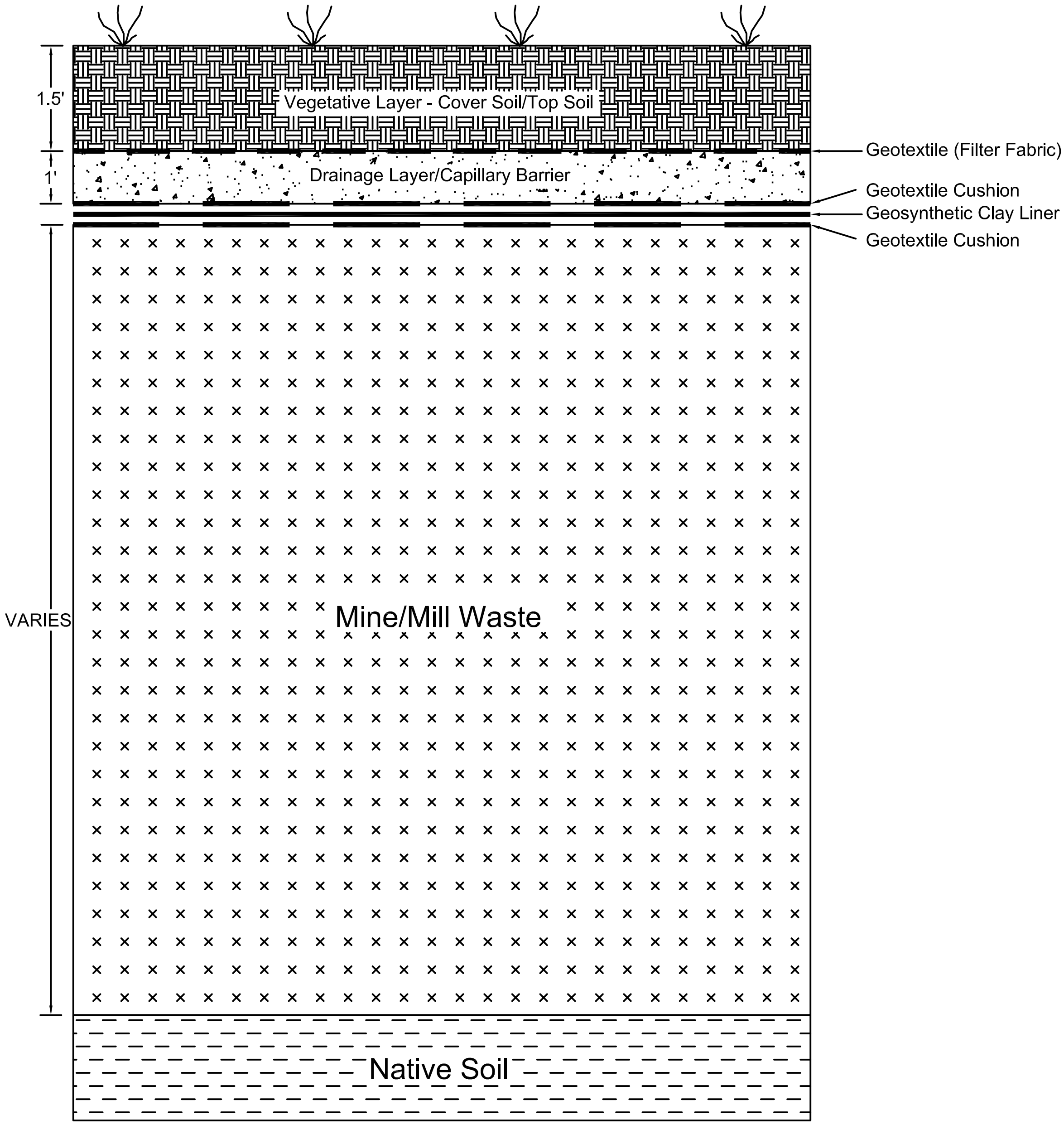
7.2.4.3 Alternative 4c: On-site Disposal in a Constructed Unlined Repository with a Multi-Layered Cap

The reclamation strategy for Alternative 4c involves removing all identified waste sources at the Bald Butte Millsite and disposing these wastes in a constructed, unlined repository with a multi-layered cap (Figure 7-3).

Effectiveness - This alternative would effectively reduce contaminant mobility at the site by removing the highest risk solid media contaminant sources and disposing of the waste in a secure disposal facility. Consequently, the surface water erosion problems associated with the site are expected to be mitigated. Contaminant toxicity and volume would not be reduced, however, the waste would be rendered immobile in a structure and physical location protected from erosion problems. Infiltration of precipitation through the waste sources and resulting migration of contaminants through the vadose zone and groundwater would also be significantly reduced. Long-term monitoring and control programs would be established to ensure continued effectiveness.

This alternative is not expected to provide as high a degree of effectiveness as provided by a constructed repository which complies with all RCRA Subtitle C regulations (Alternative 4a) or a lined repository (Alternative 4b), however, this alternative may provide adequate protection at a significantly reduced cost. Although this alternative does not comply with EPA's Minimum Technology Guidance (EPA, 1989d), the design may provide adequate environmental protection considering the chemical and physical characteristics of the mine waste in conjunction with the physical location of the repository site and the area's generally semi-arid climate. EPA's HELP Model (EPA, 1997) could be applied to the conceptual design to determine the relative effectiveness of the design and ultimately to determine the overall feasibility of the alternative and associated cost effectiveness.

Implementability - This alternative is both technically and administratively feasible. The construction steps required are considered conventional construction practices. Key project components, such as the availability of equipment, materials, and construction expertise, are all present and would help ensure the timely implementation and successful execution of the



Olympus Technical Services, Inc.				ALTERNATIVES 4C - ONSITE DISPOSAL IN AN UNLINED REPOSITORY WITH A MULTI-LAYERED CAP	FIGURE 7-3
Drawn: KSR	Checked: CRS	Date: 4/2003	Job No: A1348	MONTANA DEQ/MINE WASTE CLEANUP BUREAU BALD BUTTE MILLSITE LEWIS & CLARK COUNTY, MONTANA	
Design:	Approved:	Scale: NONE	File: A1348-567C.dwg		

proposed plan. The greatest difficulty in implementing this alternative will be water management issues. Dog Creek flows through all of the tailings piles and would need to be temporarily diverted to allow for tailings removal. The two water ponds are likely former tailings piles and will require dewatering to remove residual tailings. The presence of Dog Creek, Dago Gulch and numerous springs will make dewatering difficult.

Cost Screening - The total present-worth cost for this alternative has been estimated at $1,731,714 which represents the reclamation of all the tailings and waste rock piles present at the Bald Butte Millsite. Table 7-8 presents the cost details associated with implementing this alternative. The total cost includes the present-worth value of 30 years of annual maintenance and monitoring costs in addition to capital costs. The cost estimate assumes that a geocomposite drainage layer is used in the cap liner system rather than a washed coarse gravel.

The following assumptions were used to estimate the costs associated with this alternative:

- Requires approximately 7,300 feet of single-lane access road improvement with turnouts.
- The total volume of waste material to be excavated and disposed of in the repository is 68,770 cy.
- The mine wastes would be deposited at an average depth of approximately 12.1 feet and a maximum thickness of 21 feet.
- Cap Liner - A GCL would be installed overlaying the mine waste. A 20-mil-thick, HDPE flexible membrane liner would overlay the GCL. A geotextile cushion layer would be installed beneath the GCL to protect it from being damaged.
- Drainage Layer - A one-foot-thick layer of washed, coarse gravel would overlay the composite cap liner system. A geotextile filter fabric layer (to prevent potential clogging of the coarse gravel) would overlay the coarse gravel drainage layer. If a sufficient source of washed, coarse gravel is not available on site or near the site, a geocomposite drainage layer could be used in lieu of a one-foot-thick washed gravel layer in the cap system. The cost screening above assumes that a geocomposite drainage layer is used in the cap liner system. A cost/benefit analysis would be performed during the detailed evaluation of reclamation alternatives to determine the most cost-effective cap drainage layer design (granular drainage vs. geocomposite).
- Vegetative Cover - A two-feet-thick layer of native soil would overlay the cap drainage layer. Cover soil sources will need to be identified during detailed site characterization.
- The total length of Dog Creek stream reconstruction is 4,200 lineal feet.
- The surface area for grading and contouring of excavated source areas is 11.62 acres.
- Conventional plowing techniques would be adequate for preparing seed beds in the excavated source areas.
- The total surface area at the site requiring revegetation is approximately 16.98 acres (which includes the excavated source areas, repository cap and haul roads).

Table 7-8. Preliminary Cost Estimate for Alternative 4c: On-Site Disposal in a Constructed Unlined Repository with a Multi-Layered Cap

Task	Quantity	Units	Unit $	Cost $	Comment
Mobilization, Bonding & Insurance	1	L.S.	99,855	$99,855	8%
Logistics					
Access Road	7,300	LF	2.00	$14,600	
Site Clearing/Preparation	14.97	Ac	2,000	$29,940	
Dog Creek Stream Diversion	3,700	LF	25.00	$92,500	
Dewater Ponds	1	LS	10,000	$10,000	
Debris Removal and Onsite Disposal	1	LS	10,000	$10,000	
Repository Construction					
Repository Base Grading	3.34	Ac	2,000	$6,680	
Waste Load, Haul & Dump					
Tailings	65,220	CY	4.00	$260,880	
Waste Rock	3,550	CY	4.00	$14,200	
Waste Grading and Compaction	68,770	CY	2.00	$137,540	
Cap Construction					
Install Geotextile Cushion	16,521	SY	3.00	$49,563	
Install Geosynthetic Clay Liner	16,521	SY	4.50	$74,345	
Geocomposite Drainage Layer	16,521	SY	4.50	$74,345	
Cover Soil	11,014	CY	6.00	$66,084	
Stream Channel Reconstruction	4,200	LF	80.00	$336,000	
Water Diversion/Runon Controls					
Run-on Control Ditch	1,100	LF	2.00	$2,200	
Revegetation					
Seed/Fertilize	16.98	Ac	1,000	$16,980	
Mulch	16.98	Ac	1,000	$16,980	
Fencing					
Barbed-wire Fence	10,300	LF	2.50	$25,750	
Repository Fence	1,600	LF	6.00	$9,600	
Subtotal				$1,348,041	
Construction Oversight	15%			$202,206	
Subtotal Capital Costs				$1,550,247	
Contingency	10%			$155,025	
TOTAL CAPITAL COSTS				$1,705,272	
POST CLOSURE MONITORING AND MAINTENANCE COSTS					
Inspections	1	/Year	250	$250	
Sampling & Analysis	4	/Year	200	$800	
Maintenance	1	L.S.	1500	$1,500	
Subtotal				$2,550	
Contingency	10%			$255	
TOTAL ANNUAL O&M COST				$2,805	
TOTAL CAPITAL COSTS				$1,705,272	
PRESENT WORTH O&M COST	30	yrs @	10%	$26,442	
TOTAL PRESENT WORTH COST				$1,731,714	

- The total length of required runon/runoff control diversion ditches is approximately 1,100 lineal feet.

- A total of 10,300 lineal feet of 4-strand, barbed-wire fence and 1,600 lineal feet of repository fence will be constructed around the perimeter of the reclaimed areas.

Screening Summary

This alternative has been retained for detailed analysis due to its potential to meet reclamation goals with a proven technology.

7.2.5 Alternative 5: Off-Site Disposal in a Permitted Solid Waste Disposal Facility

The reclamation strategy for Alternative 5 involves removing all identified waste sources at the Bald Butte Millsite and disposing of these wastes in a Class II Municipal Solid Waste (MSW) Landfill. The sources to be disposed of include the six tailings piles and the four waste rock piles. The nearest Class II MSW landfill is the Lewis and Clark County landfill, which is within 40 miles of the site.

In order for the waste to be accepted at a Class II MSW landfill, it would have to pass the Toxicity Characteristic Leaching Procedure (TCLP) test. Neither the mill tailings or the waste rock were tested according to TCLP methods during the preliminary assessment. The tailings and waste rock materials of concern are derived from the beneficiation and extraction of ores and are therefore exempt from federal regulation under the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. 6921 (b) (3) (A)(iii)(1994) as a hazardous waste.

Removal of the tailings would require the construction of a temporary diversion of Dog Creek while excavating the tailings. A considerable amount of heavy equipment/machinery would be necessary to efficiently implement this alternative. To excavate and load out the contaminated material, as well as construct runon/runoff control structures, equipment requirements would include, but not be limited to, multiple bulldozers, front end loaders and excavators. Haul trucks would be used to transport the material to the facility, which is located approximately 40 miles east of the site. The number of haul trucks and loaders would have to be selected and scheduled very carefully to optimize loading cycle times and reduce construction costs as much as possible.

After the excavation and loadout are complete, the excavated areas would be revegetated. Cover/fill soil may be required in the excavated areas to level out and contour the areas to match the surrounding terrain. The seed beds would be prepared using conventional agricultural plowing. Seeding would take place during the fall of the year. The seed mixture and fertilizer would be applied simultaneously to the prepared seed beds via drill application. Disturbed surfaces are susceptible to erosion until vegetation is established. Therefore, mulch would be applied to promote temporary protection of exposed erodible surfaces. Wheat or barley straw mulch (certified weed-free) would be applied over the excavated areas with a tow spreader or pneumatic spreader utilizing tucking/crimping as the anchoring mechanism.

Effectiveness - This alternative would effectively reduce contaminant mobility at the site by completely removing the highest risk solid media contaminant sources from the site. Contaminant toxicity and volume would not be reduced. Removal of wastes to a Class II MSW landfill facility provides long-term monitoring and control programs to ensure continued effectiveness. However, short-term risks of exposure to the contaminated material may occur during transport to the disposal facility.

Implementability - This alternative is technically feasible. The construction steps required (excavation and loadout) are considered standard construction practices. Key project components, such as the availability of personnel, equipment and materials, are present and would help allow the timely implementation and successful execution of the proposed plan. The administrative feasibility is questionable based on the waste disposal regulatory rules, landfill permit requirements, and multiple agency approval requirements, and the negative perception of the waste.

Cost Screening - The total present-worth cost for this alternative has been estimated at $5,855,470 which represents the reclamation of all the tailings and waste rock piles present at the Bald Butte Millsite. Table 7-9 presents the cost details associated with implementing this alternative. The total cost includes the present-worth value of 30 years of annual maintenance and monitoring costs in addition to capital costs.

The following assumptions were used to estimate the costs associated with this alternative:

- Requires approximately 7,300 feet of single-lane access/haul road improvement with turnouts.
- Based on the estimated waste volume of 68,770 cy, the total tonnage of waste material to be removed from the site has been estimated at 96,278 tons.
- The waste material would be hauled by truck to the Lewis and Clark County Landfill, located near East Helena, Montana.
- The total length of Dog Creek stream reconstruction is 4,200 lineal feet.
- Conventional plowing techniques would be adequate for preparing seed beds in the excavated areas.
- The surface area for grading and contouring of excavated source areas is 11.62 acres.
- The total surface area at the site requiring revegetation is approximately 13.64 acres.
- A total of 10,300 lineal feet of 4-strand, barbed-wire fence will be constructed around the perimeter of the reclaimed areas.

Screening Summary

This alternative has not been retained for further evaluation due to extremely high costs. A similar degree of relative effectiveness can be obtained by other alternatives being evaluated at significantly reduced costs.

Table 7-9. Preliminary Cost Estimate for Alternative 5: Off-Site Disposal of Tailings in a Permitted Solid Waste Disposal Facility

Task	Quantity	Units	Unit $	Cost $	Comment
Mobilization, Bonding & Insurance	1	LS	341,814	$341,814	8%
Logistics					
Access Road	7,300	LF	2.00	$14,600	
Site Clearing/Preparation	13.64	Ac	2,000	$27,280	
Dog Creek Stream Diversion	3,700	LF	25.00	$92,500	
Dewater Ponds	1	LS	10,000	$10,000	
Debris Removal and Onsite Disposal	1	LS	10,000	$10,000	
Waste Load, Haul & Dump					
Waste Excavation & Loading	68,770	CY	2.00	$137,540	
Decon	68,770	CY	0.25	$17,193	
Transportation					
Transportation to Disposal Facilty	87,338	CY	15.00	$1,310,070	27% Swell
DISPOSAL					
Disposal Charge	96,278	Ton	22.50	$2,166,255	Disp. Facility Estimate
Special Handling	96,278	Ton	1.02	$98,204	Disp. Facility Estimate
Stream Channel Reconstruction	4,200	LF	80.00	$336,000	
Revegetation					
Seed/Fertilize	13.64	Ac	1,000	$13,640	
Mulch	13.64	Ac	1,000	$13,640	
Fencing					
Barbed-wire Fence	10,300	LF	2.50	$25,750	
Subtotal				$4,614,485	
Construction Oversight	15%			$692,173	
Subtotal Capital Costs				$5,306,658	
Contingency	10%			$530,666	
TOTAL CAPITAL COSTS				$5,837,324	
POST CLOSURE MONITORING AND MAINTENANCE COSTS					
Inspections	1	/Year	250	$250	
Maintenance	1	L.S.	1500	$1,500	
Subtotal				$1,750	
Contingency	10%			$175	
TOTAL ANNUAL O&M COST				$1,925	
TOTAL CAPITAL COSTS				$5,837,324	
PRESENT WORTH O&M COST	30	yrs @	10%	$18,147	
TOTAL PRESENT WORTH COST				$5,855,470	

7.2.6 Alternative 6: Off-Site Disposal in a RCRA-Permitted Hazardous Waste Disposal Facility

The reclamation strategy for Alternative 6 involves removing all identified waste sources at the Bald Butte Millsite and disposing of these wastes in a RCRA-permitted hazardous waste disposal facility, pending profiling and acceptance of the waste at the disposal facility. The sources to be disposed of include the six tailings piles and the four waste rock piles. The two nearest RCRA-permitted hazardous waste disposal facilities with the capacity to dispose of the wastes are both located several hundred miles from the site (one facility is located in Idaho, the other in Oregon).

Removal of the tailings would require the construction of a temporary diversion of Dog Creek while excavating the tailings. A considerable amount of heavy equipment would be necessary to efficiently implement this alternative. To load out the contaminated material, equipment requirements would include, but not be limited to, multiple bulldozers, front end loaders, and excavators. Haul trucks would be used to transport the material to a local rail facility, where it would be transferred into gondola cars and shipped by rail to the RCRA facility. The field procedure would first involve constructing a single lane haul road with turnouts in the vicinity of the waste sources at the site to allow unobstructed access for haul trucks.

After the excavation and loadout are complete, the excavated areas would be revegetated. Cover/fill soil may be required in the excavated areas to level out and contour the areas to match the surrounding terrain. The seed beds would be prepared using conventional agricultural plowing. It is recommended that seeding take place during the fall of the year. The seed mixture and fertilizer would be applied simultaneously to the prepared seed beds via drill application. Disturbed surfaces are susceptible to erosion until vegetation is established. Therefore, mulch would be applied to promote temporary protection of exposed erodible surfaces. Wheat or barley straw mulch (certified weed-free) would be applied over the excavated areas with a tow spreader or pneumatic spreader utilizing tucking/crimping as the anchoring mechanism.

<u>Effectiveness</u> - This alternative would effectively reduce contaminant mobility at the site by removing the contaminant sources. Consequently, the site problems are expected to be permanently corrected. Contaminant toxicity and volume would not be reduced, but would be permanently transferred to a different physical location. Disposal at a RCRA-permitted facility establishes long-term monitoring and control programs to enhance continued effectiveness. However, short-term risks of exposure to the contaminated material would occur during transport to the disposal facility.

<u>Implementability</u> - This alternative is both technically and administratively feasible. The construction steps required (excavation and loadout) are considered standard construction practices. Key project components, such as the availability of equipment, materials, and a RCRA facility with adequate capacity, are present and would allow for the timely implementation and successful execution of the proposed plan.

<u>Cost Screening</u> - The total present-worth cost for this alternative has been estimated at $16,597,370 which represents the reclamation of all of the tailings and waste rock piles present at the Bald Butte Millsite. Table 7-10 presents the cost details associated with implementing this alternative. The total cost includes the present-worth value of 30 years of annual maintenance and monitoring costs in addition to capital costs.

Table 7-10. Preliminary Cost Estimate for Alternative 6: Off-Site Disposal in a RCRA-Permitted Hazardous Waste Disposal Facility

Task	Quantity	Units	Unit $	Cost $	Comment
Mobilization, Bonding & Insurance	1	L.S.	970,823	$970,823	8%
Logistics					
Access Road	7,300	LF	2.00	$14,600	
Site Clearing/Preparation	13.64	Ac	2,000	$27,280	
Dog Creek Stream Diversion	3,700	LF	25.00	$92,500	
Dewater Ponds	1	LS	10,000	$10,000	
Debris Removal and Onsite Disposal	1	LS	10,000	$10,000	
Waste Load, Haul & Dump					
Waste Excavation & Loading	68,770	CY	2.00	$137,540	
Waste Hauling to Rail Transfer	87,338	CY	13.00	$1,135,394	27% Swell
Decon	68,770	CY	0.25	$17,193	
Rail Transportation					
Transportation to Disposal Facilty	96,278	Ton	37.00	$3,562,286	Rail Shipment Estimate
DISPOSAL					
Profiling Charge	1	LS	200.00	$200	Disp. Facility Estimate
Profiling Charge Credit	1	LS	-200.00	($200)	Disp. Facility Estimate
Disposal Charge	96,278	Ton	45.00	$4,332,510	Disp. Facility Estimate
Tax Charge	96,278	Ton	25.00	$2,406,950	Disp. Facility Estimate
Stream Channel Reconstruction	4,200	LF	80.00	$336,000	
Revegetation					
Seed/Fertilize	13.64	Ac	1,000	$13,640	
Mulch	13.64	Ac	1,000	$13,640	
Fencing					
Barbed-wire Fence	10,300	LF	2.50	$25,750	
Subtotal				$13,106,106	
Construction Oversight	15%			$1,965,916	
Subtotal Capital Costs				$15,072,021	
Contingency	10%			$1,507,202	
TOTAL CAPITAL COSTS				$16,579,223	
POST CLOSURE MONITORING AND MAINTENANCE COSTS					
Inspections	1	/Year	250	$250	
Maintenance	1	L.S.	1500	$1,500	
Subtotal				$1,750	
Contingency	10%			$175	
TOTAL ANNUAL O&M COST				$1,925	
TOTAL CAPITAL COSTS				$16,579,223	
PRESENT WORTH O&M COST	30	yrs @	10%	$18,147	
TOTAL PRESENT WORTH COST				$16,597,370	

The following assumptions were used to estimate the costs associated with this alternative:

- Requires approximately 7,300 feet of single-lane access road improvement with turnouts.
- Based on the estimated waste volume of 68,770 cy, the total tonnage of waste material to be removed from the site has been estimated at 96,278 tons.
- The waste material would be hauled by truck to a suitable transfer area, where it would be loaded out and shipped by rail.
- The total length of Dog Creek stream reconstruction is 4,200 lineal feet.
- The surface area for grading and contouring of excavated source areas is 11.62 acres.
- Conventional plowing techniques would be adequate for preparing seed beds in the excavated areas.
- The total surface area at the site requiring revegetation is approximately 13.64 acres.
- A total of 10,300 lineal feet of 4-strand, barbed-wire fence will be constructed around the perimeter of the reclaimed areas.

Screening Summary

This alternative has not been retained for further evaluation due to extremely high costs. A similar degree of relative effectiveness can be obtained by several other alternatives being evaluated at significantly reduced costs.

7.3 ALTERNATIVES SCREENING SUMMARY

Table 7-11 summarizes the findings of the alternatives screening exercise. Costs generated and summarized in Table 7-11 are present-worth values which include construction costs, as well as operation/monitoring and maintenance costs, for a 30-year period. These cost estimates are order-of-magnitude estimates generated for planning purposes. Cost estimates will be refined during the detailed analysis of alternatives, which includes the more detailed site characterization data.

Off-site disposal in licensed and permitted solid waste (Alternative 5) and RCRA disposal facilities (Alternative 6) will not be retained for detailed analysis due to extremely high costs. A similar degree of effectiveness could be attained at a significantly reduced cost by implementing other alternative(s).

7.4 ALTERNATIVES REFINEMENT PROCESS

The alternatives development and screening process developed a variety of reclamation alternative derivatives for the Bald Butte Millsite and Devon/Sterling and Albion Mines project. A total of eight reclamation alternatives including the no action alternative, as well as several variations of Alternative 4 were preliminarily developed, presented, and evaluated in the

TABLE 7-11 ALTERNATIVES SCREENING SUMMARY

ALTERNATIVE DESCRIPTION	EFFECTIVE	IMPLEMENTABLE	COST ESTIMATE	RETAINED FOR DETAILED ANALYSIS
ALT. 1: No Action	NA	NA	$0	Yes
ALT. 2: Institutional Controls	Low	Yes	$321,542	No
ALT. 3: Partial Consolidation/In-Place Containment	Medium	Yes	$1,269,741	Yes
ALT. 4a: On-site Disposal in RCRA Subtitle C Repository	High	Yes	$2,487,721	Yes
ALT. 4b: On-site Disposal in Constructed Modified RCRA Repository	High	Yes	$2,175,880	Yes
ALT. 4c: On-site Disposal in a Constructed Unlined Repository With a Multi-layered Cap	Medium-High	Yes	$1,731,714	Yes
ALT. 5: Off-Site Disposal - Solid Waste Permitted Facility	High	Questionable	$5,855,470	No
ALT. 6: Off Site Disposal - RCRA Permitted Hazardous Waste Facility	High	Yes	$16,597,370	No

Reclamation Work Plan (DEQ-MWCB/Olympus, 2003f) and reviewed in Section 7.2. Of the eight alternatives evaluated, five were recommended for further "detailed" analysis. However, additional data from the site characterization support eliminating some alternatives and adding or modifying others for a more detailed analysis. These alternatives were developed prior to the inclusion of the Devon/Sterling and Albion Mines with the Bald Butte Millsite. Therefore, alternatives must be included that address the Devon/Sterling and Albion Mine waste rock piles.

All six of Bald Butte Millsite tailings piles are located in the active stream drainage and there are springs and/or shallow groundwater levels in the vicinity of the tailings. Because of the shallow groundwater and the proximity of the tailings piles to the stream and floodplain, in-place containment of the tailings is not considered appropriate for this site. Instead, Alternative 3 will be modified to include in-place containment of selected waste rock piles. Waste rock piles WR2A and a portion of WR1A will be contained in place under Alternative 3. Alternative 4 will be modified to include placement of waste rock piles WR-1 through WR-4, WR3A, and a portion of WR1A in an on-site repository. The site characterization did not reveal the presence of significant borrow sources for clay liner material in the vicinity of the site. Importing clay suitable for liner construction for a RCRA repository would be very expensive. A modified RCRA repository utilizing a GCL can be used in lieu of a compacted clay liner. Therefore, Alternative 4a will be modified to include a GCL rather than a compacted clay liner, and no flexible membrane liners will be included in the base or cap liner system.

A final alternative, Alternative 7, that includes disposal of all tailings and waste rock sources in an on-site repository will be added. This alternative will provide another option for disposal of all waste rock sources besides in-place containment. Alternative 7a (RCRA repository with a GCL substituted for a compacted clay liner), Alternative 7b (modified RCRA repository similar to Alternative 4b) and 7c (unlined repository with a multi-layered cap) will be evaluated in detail. Table 7-12 presents the alternatives that will be evaluated in detail.

TABLE 7-12 ALTERNATIVES RETAINED FOR DETAILED ANALYSIS

Alternative 1:	No Action
Alternative 3:	Partial In-Place Containment of Devon/Sterling and Albion Waste Rock
Alternative 4a:	On-Site Disposal of Tailings and Selected Waste Rock in a Constructed RCRA Repository
Alternative 4b:	On-Site Disposal of Tailings and Selected Waste Rock in a Constructed Modified RCRA Repository
Alternative 4c:	On-Site Disposal of Tailings and Selected Waste Rock in a Constructed Unlined Repository with a Multi-Layered Cap
Alternative 7a:	On-Site Disposal of Tailings and Waste Rock in a Constructed RCRA Repository
Alternative 7b:	On-Site Disposal of Tailings and Waste Rock in a Constructed Modified RCRA Repository
Alternative 7c:	On-Site Disposal of Tailings and Waste Rock in a Constructed Unlined Repository with a Multi-Layered Cap

8.0 DETAILED ANALYSIS OF RECLAMATION ALTERNATIVES

The purpose of the detailed analysis is to evaluate, in further detail, reclamation alternatives for their effectiveness, implementability, and cost to control and reduce the toxicity, mobility, and/or volume of contaminated mine/mill wastes associated with the Bald Butte Millsite and Devon/Sterling and Albion Mines project. Only those reclamation alternatives which were retained after the preliminary evaluation in Section 7.2 and were further screened in the Section 7.4 alternative refinement process are included. Each reclamation alternative currently being considered for implementation for the Bald Butte Millsite and Devon/Sterling and Albion Mines project is classifiable as an interim or removal action and is not a complete reclamation action. The reclamation alternatives are applicable to the contaminated solid media only; no reclamation alternatives have been developed or evaluated for active treatment of groundwater, surface water, or off-site stream sediments. The rationale for not directly developing remedial alternatives for these environmental media was based primarily on the presumption that reclaiming the contaminant source(s) will subsequently reduce or eliminate the problems associated with surface water, groundwater, and off-site stream sediments at a significantly reduced cost.

As required by the CERCLA and the NCP, reclamation alternatives that were retained after the initial evaluation and screening have to be evaluated individually against the following criteria:

- overall protection of human health and the environment;
- compliance with ARARs;
- long-term effectiveness and permanence;
- reduction of toxicity, mobility, or volume through treatment;
- short-term effectiveness;
- implementability; and
- cost.

Supporting agency acceptance and community acceptance are additional criteria that will be addressed after DEQ-MWCB and the public have a chance to review the evaluations presented. The analysis criteria have been used to address the CERCLA requirements and considerations with EPA guidance (EPA, 1988), as well as additional technical and policy considerations. These analysis criteria serve as the basis for conducting the detailed analysis and subsequently selecting the preferred reclamation alternative. The criteria listed above are categorized into three groups, each with distinct functions in selecting the preferred alternative. These groups include:

- Threshold Criteria - overall protection of human health and the environment and compliance with ARARs;
- Primary Balancing Criteria - long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost; and
- Modifying Criteria - state and community acceptance.

Overall protection of human health and the environment and compliance with applicable or relevant and appropriate requirements are threshold criteria that must be satisfied for an alternative to be eligible for selection. Long-term effectiveness and permanence; reduction of toxicity, mobility, or volume; short-term effectiveness; implementability; and cost are the primary balancing factors used to weigh major trade-offs between alternative waste management strategies. State and community acceptance are modifying considerations that are formally considered after public comment is received on the proposed plan and the Expanded EE/CA report (Federal Register, No. 245, 51394-50509, December 1988). Each of these criteria is briefly described in the following paragraphs.

Compliance with ARARs criteria assesses how each alternative complies with applicable or relevant and appropriate standards, criteria, advisories, or other guidelines. Waivers will be identified, if necessary. The following factors will be addressed for each alternative during the detailed analysis of ARARs:

- compliance with chemical-specific ARARs;
- compliance with action-specific ARARs;
- compliance with location-specific ARARs; and
- compliance with appropriate criteria, advisories, and guidelines.

Long-term effectiveness and permanence evaluates the alternative's effectiveness in protecting human health and the environment after response objectives have been met. The following components of the criteria will be addressed for each alternative:

- magnitude of remaining risk;
- adequacy of controls; and
- reliability of controls.

The reduction of toxicity, mobility, or volume assessment evaluates anticipated performance of the specific treatment technologies. This evaluation focuses on the following specific factors for a particular reclamation alternative:

- the treatment process, the remedies they will employ, and the materials they will treat;
- the amount of hazardous materials that will be destroyed or treated, including how principal threat(s) will be addressed;
- the degree of expected reduction in toxicity, mobility, or volume measured as a percentage of reduction (or order of magnitude);
- degree to which the treatment will be irreversible; and
- the type and quantity of treatment residuals that will remain following treatment.

Short-term effectiveness evaluates an alternative's effectiveness in protecting human health and the environment during the construction and implementation period until the response objectives are met. Factors that will be considered under this criteria include:

- protection of the surrounding community during reclamation actions;
- protection of on-site workers during reclamation actions;
- protection from environmental impacts; and
- time until removal response objectives are achieved.

Implementability evaluates the technical and administrative feasibility of alternatives and the availability of required resources. Analysis of this criterion will include the following factors and subfactors:

Technical Feasibility

- construction and operation;
- reliability of technology;
- ease of undertaking additional remedial action; and
- monitoring considerations.

Administrative Feasibility

- RCRA disposal restrictions;
- institutional controls; and
- permitting requirements.

Availability of Services and Materials

- adequate off-site treatment, storage capacity, and disposal service;
- necessary equipment and specialists and provisions to ensure any necessary additional resources;
- timing of the availability of technologies under consideration; and
- services and materials.

The cost assessment evaluates the capital and operation and maintenance (O&M) costs of each alternative. A present-worth analysis based on a 10-percent inflation rate and a maximum design life of 30 years will be used to compare alternatives. Cost screening consists of developing conservative, order-of-magnitude cost estimates based on similar sets of site-specific assumptions. Cost estimates for each alternative will consider the following factors:

Capital Costs

- construction costs;
- equipment costs;
- land and site development costs;
- disposal costs;
- engineering design;
- legal fees, license, and permit costs;
- startup and troubleshooting costs; and
- contingency allowances.

Annual Costs

- operating labor;
- maintenance materials and labor;
- auxiliary materials and energy;
- disposal residues;
- purchased services (i.e., sampling costs, laboratory fees, professional fees);
- administrative costs;
- insurance, taxes, and licensing;
- maintenance reserve and contingency funds;
- rehabilitation costs; and
- periodic site reviews.

State acceptance will evaluate the technical and administrative issues and concerns the state may have regarding each of the alternatives. State acceptance will also focus on legal issues and compliance with state statutes and regulations. Community acceptance will incorporate public concerns into the analyses of the alternatives.

The final step of this process is to conduct a comparative analysis of the alternatives. The analysis will include a discussion of the alternative's relative strengths and weaknesses with respect to each of the criteria and how reasonable key uncertainties could change expectations of their relative performance.

Once completed, this evaluation will be used to select the preferred alternative(s). The selection of the preferred alternative(s) will be documented in a Record of Decision. Public meetings to present the alternatives will be conducted and significant oral and written comments will be addressed in writing.

8.1 ALTERNATIVE 1: NO ACTION

The no action alternative means that no reclamation is done at the site to control contaminant migration or to reduce toxicity or volume. This option would require no further reclamation investigation or monitoring action at the site. The no action response is generally used as a baseline against which other reclamation options can be compared. This alternative has been retained for further evaluation as suggested by the NCP.

8.1.1 Overall Protection of Human Health and the Environment

The no action alternative provides no control of exposure to the contaminated materials and no reduction in risk to human health or the environment. It allows for the continued migration of contaminants and further degradation of water and air.

Protection of human health would not be achieved under the no action alternative. Prevention of direct human exposure via the pathways of concern would not be achieved. Risk from water/fish ingestion of manganese would not be reduced. Carcinogenic risk from ingestion of arsenic via water/fish ingestion would not be reduced to 1E-06. Risk from soil ingestion/dust inhalation of arsenic, lead and manganese would not be reduced. Carcinogenic risk from soil ingestion/dust inhalation of arsenic would not be reduced to 1E-06. Protection of the environment would also not be achieved under the no action alternative. Prevention of ecological exposures via exposure to water, sediment and soil sources would not be achieved; deer exposure to lead via ingestion of tailings salts would not be reduced; plant phytotoxicity to arsenic, cadmium, copper lead, manganese and zinc would not be reduced; acute aquatic life exposures to cadmium and zinc in surface water would not be reduced, and aquatic life exposures to arsenic, cadmium, copper, lead and zinc in sediment would not be reduced. A risk reduction achievement matrix for the various pathways and contaminants, identified in the baseline human health risk assessment and the ecological risk assessment, is shown in Table 8-1.

Table 8-1. Risk Reduction Achievement Matrix for Alternative 1

Exposure Pathway	Risk Level	Arsenic		Cadmium		Copper		Lead		Manganese		Zinc	
		Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal
Human Risk:													
Water Ingestion/Fish Ingestion Pathway (ug/l)	HQ=1	36.7	Yes					165	Yes	33.7	No		
	Carc. 1E-06	0.158	No										
	Carc. 1E-05	1.58	No										
	Carc. 1E-04	15.8	Yes										
Soil Ingestion/Dust Inhalation Pathway (mg/Kg)	HQ=1	323	No					2200	No	1330	No		
	Carc. 1E-06	1.39	No										
	Carc. 1E-05	13.9	No										
	Carc. 1E-04	139	No										
Ecological Risk Scenario:	EQ=1												
Deer - Tailings Salt Ingestion (mg/Kg)	LOAEL	NA		NA		NA		314	No	NA		NA	
Plant Phytotoxicity - Soil (mg/Kg)	Max Phytotox.	50	No	8	No	125	No	400	No	3000	No	400	No
Aquatic Life - Water (ug/l)	AALS	340	Yes	2.1	No	14	Yes	81.6	Yes	NA		120	No
Aquatic Life - Sediment (mg/Kg)	PSQC	85	No	9	No	390	No	110	No	NA		270	No

Notes: NA - Not Applicable

LOAEL - Lower observed adverse effect level

AALS - Freshwater Acute Aquatic Life Standards (DEQ, 2002). Hardness = 100 mg/l CaCO3 for hardness dependent elements.

PSQC - Proposed Sediment Quality Criteria

Table 8-2. Water Quality ARARs Attainment for Alternative 1

	Arsenic		Cadmium		Copper		Lead		Manganese		Zinc	
	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal
Drinking Water MCL/HHS	18	Yes	5	Yes	1300	Yes	15	Yes	50	No	2000	Yes
Aquatic Life CALS	150	Yes	0.27	No	9.3	Yes	3.2	No	NA		119.8	No

HHS - Human Health Standards for Surface Water (DEQ, 2002)

MCL - Maximum Contaminant Level Drinking Water Regulations and Health Advisories, (EPA, 1993)

CALS - Freshwater Chronic Aquatic Life Standards (DEQ, 2002)

Water concentrations in ug/L.

CALS based on water hardness of 100 mg/L.

8.1.2 Compliance with ARARs

A comprehensive list of federal and state Applicable or Relevant and Appropriate Requirements (ARARs) has been developed for the Bald Butte Millsite and Devon/Sterling and Albion Mine sites and is summarized in Section 4.0. ARARs are divided into contaminant-specific, location-specific, and action-specific requirements. Contaminant-specific ARARs are waste-related requirements which specify how a waste must be managed, treated, and/or disposed depending upon the classification of the waste material. Location-specific ARARs specify how the remedial activities must take place depending upon where the wastes are physically located (i.e., in a stream or floodplain, wilderness area, or sensitive environment, etc.), or where the wastes may be treated or disposed, and what authorizations (permits) may be required. Action-specific ARARs do not determine the preferred reclamation alternative, but indicate how the selected alternative must be achieved.

Under the no action alternative, no contaminated materials would be treated, removed, or actively managed. Consequently, the no action alternative would not satisfy any federal or state contaminant-specific ARARs. Water quality ARARs not attained in surface water are listed in Table 8-2. Location and action specific ARARs are not applicable.

8.1.3 Long-Term Effectiveness and Permanence

Toxicity, mobility, and volume of contaminants would not be reduced under the no action alternative. Also, protection of human health and the environment would not be achieved under this alternative. No control measures would be completed on the waste sources identified as causing environmental impacts at the site. The no action alternative would not address surface water impacts that have been identified nor would it provide controls on contaminant migration via direct contact or particulate emissions.

8.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

The no action alternative would provide no reduction in toxicity, mobility, or volume of the contaminated materials.

8.1.5 Short-Term Effectiveness

Short-term effectiveness is not applicable.

8.1.6 Implementability

Technical and administrative feasibility evaluation criteria do not apply to this alternative.

8.1.7 Costs

No capital or operating costs would be incurred under this alternative.

8.2 ALTERNATIVE 3: PARTIAL IN-PLACE CONTAINMENT OF DEVON/STERLING AND ALBION WASTE ROCK

In general, in-place containment involves establishing vegetation on the surface of a solid media contaminant source. The purpose of establishing vegetation is to stabilize the surface by providing erosion protection and to decrease net infiltration through the waste by increasing evapotranspiration. If vegetation cannot be established directly on the waste source, cover materials may be used as a growth media. Cover materials may range from soil amendments and/or a single-layered soil cover to a complex, multi-layered cover consisting of various materials. The critical factor in the long-term stability of the an in-place containment strategy is the control of surface runoff over the waste source.

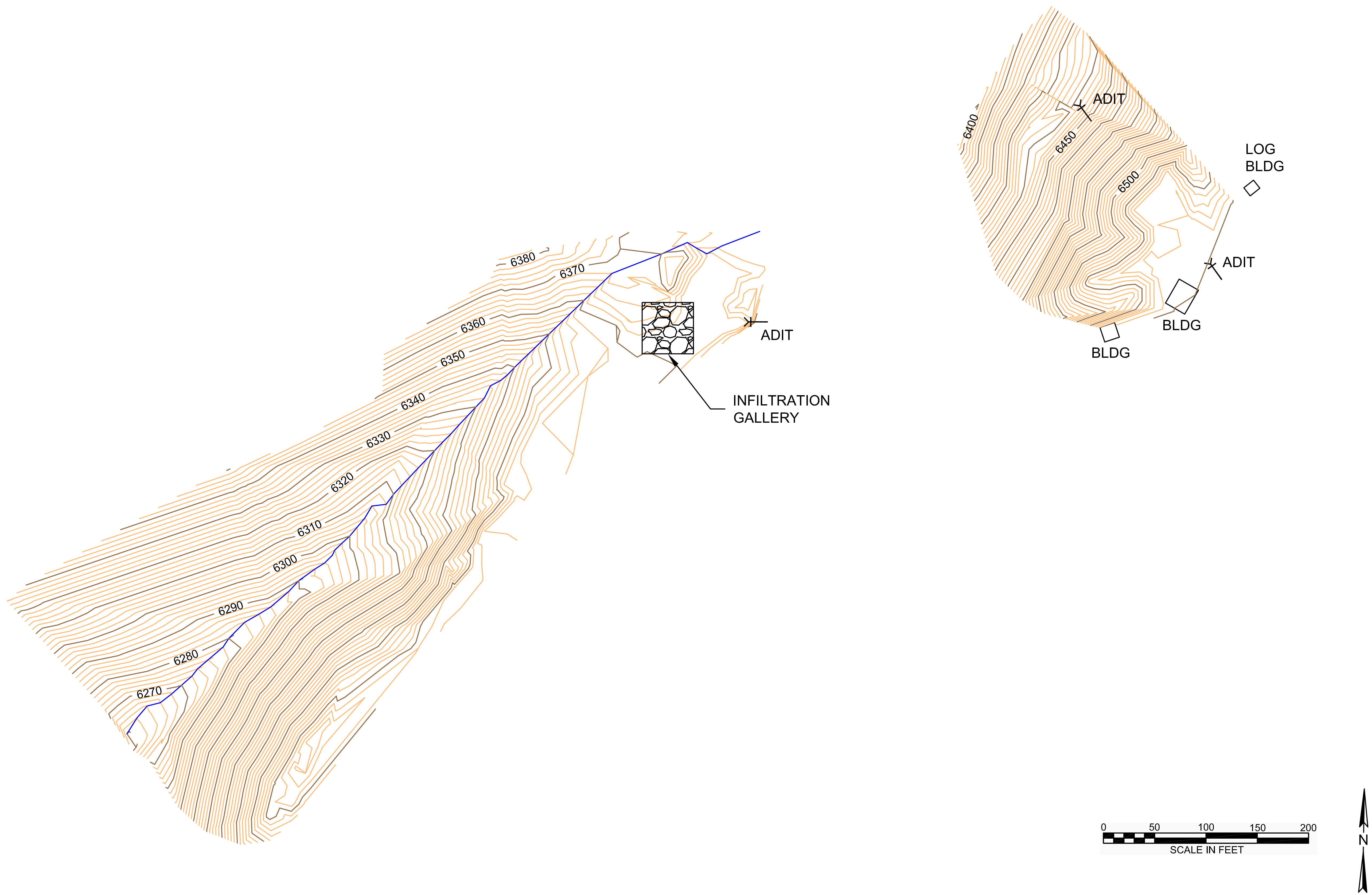
Soil covers would be difficult to construct on the existing waste rock piles at the site because of the steep terrain. The waste rock piles would have to be graded to achieve flatter slopes to effectively place cover soil. Soil covers are often subject to severe surface water erosion problems when placed on slopes steeper than 3H:1V. Therefore, soil amendments and/or covers are not considered to be feasible on the waste rock piles. Based on field observation, erosion is not a significant problem at any of the waste rock piles, with the exception of WR1A, which has a stream that flows over the top and down the face of the pile.

Given the above considerations, the conceptual design for Alternative 3 involves leaving waste rock pile WR2A and the majority of WR1A in place in their current conditions. An unnamed tributary to Dog Creek currently flows through the toe of waste rock pile WR3A and over the crest of waste rock pile WR1A. Therefore, a portion of WR1A would be removed to allow the unnamed tributary to be rerouted from its current path over WR1A and reconstructed to the north of WR1A. Because of its small volume and location near the unnamed tributary, waste rock pile WR3A would be removed and placed in a mine/mill waste repository. Figure 8-1 shows the conceptual design for Alternative 3.

Alternative 3 addresses waste rock only at the Devon/Sterling and Albion Mines and is not considered to be a stand-alone reclamation alternative. Alternative 3 would be implemented in conjunction with Alternative 4a, 4b or 4c, which address tailings and waste rock associated with the Bald Butte Millsite. Alternatives 4a, 4b and 4c present three options for the construction of a mine waste repository. The waste rock removed from the Devon/Sterling and Albion Mines under Alternative 3 would be placed in one of the mine waste repository options under Alternative 4.

The flowing adit at waste rock pile WR1A (sample GW1) exceeds Federal MCLs and Montana HHS for Cd (18 ug/L) and Mn (310 ug/L), and Montana HHS for Zn (3,550 ug/l). In addition, Cd, Cu and Zn exceed acute and chronic ALS and Pb exceeds chronic ALS in the mine adit discharge water. The underground workings are the most likely source of metals in the adit discharge. Sealing the adits to stop the discharge is not considered a reliable control measure because the flow will likely build up in the extensive underground workings and emerge uncontrolled from another location. Based on the above discussion, there is no effective means to control the discharge without the use of high-cost, high-maintenance treatment systems. Long-term treatment of the adit discharge water is considered cost prohibitive and infeasible.

Under Alternative 3, the adit discharge water would be collected near the adit opening and conveyed to an infiltration gallery in the valley floor where it will infiltrate into the alluvium. The purpose of the infiltration gallery is to eliminate the potential ingestion of the adit discharge water.



				DESIGN:	DRAWN: KSR	CHECKED: CRS	MONTANA DEQ/MINE WASTE CLEANUP BUREAU BALD BUTTE MILLSITE AND MINES LEWIS & CLARK COUNTY, MONTANA
				APPROVED:	DATE: 9/2004	JOB NO: A1432	
NO.	REVISION DESCRIPTION	BY	DATE	SCALE: AS SHOWN	FILENAME: A1432BButte.dwg		

Olympus Technical Services, Inc.

PRELIMINARY DESIGN
OF ALTERNATIVE 3

FIGURE
8-1

Acid-base accounting data and waste rock pH data (Section 3.2.4) indicate that most of the Devon/Sterling and Albion Mines waste rock is moderately acidic to neutral. ABA and NAG pH data indicate that waste rock pile WR3A is potentially acid generating. Under this alternative, WR3A would be extracted and placed in the repository. The likely low acid generating potential of the WR1A and WR2A supports in-place containment.

8.2.1 Overall Protection of Human Health and the Environment

In the case of waste rock piles WR1A and WR2A, no soil cover would be placed on the waste rock piles. Therefore, the in-place containment alternative would not provide for control of direct exposure to the contaminated materials. However, waste rock would be extracted from the unnamed tributary to Dog Creek, which would reduce risk to the environment and reduce further erosion and migration of contaminants from source areas.

Exposure to arsenic and lead via ingestion of water/fish is expected to eventually be reduced to below risk-based cleanup goals since further erosion of contaminated sediments into the unnamed tributary to Dog Creek would be prevented. Exposure to manganese via ingestion of water/fish is expected to eventually be reduced to background levels, but will not be reduced below risk-based cleanup goals. Carcinogenic risk from ingestion of arsenic via ingestion of water/fish would not be reduced to 1E-06. Cleanup below background concentrations is not considered achievable. Routing of the adit discharge water to an infiltration gallery would eliminate ingestion of the water, which exceeds both human health and aquatic life standards.

Soil ingestion and dust inhalation of arsenic and lead would be reduced to below risk-based cleanup goals. Risk-based cleanup goals would not be achieved for soil ingestion and dust inhalation of manganese. Carcinogenic risk from soil ingestion/dust inhalation of arsenic would not be reduced to 1E-06.

Protection of the environment would generally be enhanced under the partial in-place containment alternative, however, not all risk-based cleanup goals would be met. Since the waste rock sources would be removed from the unnamed tributary to Dog Creek, arsenic, cadmium, copper lead and zinc concentrations in the surface water would be reduced to levels consistent with background, which would meet acute aquatic life standards. Similarly, arsenic, cadmium, lead, copper, lead, manganese and zinc concentrations in stream sediments would be reduced as existing sediments are either diluted by mixing with natural sediment or through bedload dispersion downstream; however, lead and zinc concentrations may not be reduced to below proposed sediment quality criteria. Deer exposure to lead via ingestion of tailings and plant phytotoxicity to arsenic, cadmium, copper, lead and zinc would not be reduced to risk-based cleanup goals. A risk reduction achievement matrix for the various pathways and contaminants, identified in the baseline human health risk assessment and the ecological risk assessment, is shown in Table 8-3.

8.2.2 Compliance with ARARs

With the exception of lead and manganese, contaminant-specific ARARs are expected to be met when implementing this alternative. Table 8-4 shows that drinking water MCLs and/or HHS for arsenic, cadmium, copper, lead and zinc and ambient water quality criteria for arsenic and zinc are achieved in the unnamed tributary to Dog Creek under this alternative. This is based

Table 8-3. Risk Reduction Achievement Matrix for Alternative 3

Exposure Pathway	Risk Level	Arsenic Cleanup Goal	Arsenic Achieve Goal	Cadmium Cleanup Goal	Cadmium Achieve Goal	Copper Cleanup Goal	Copper Achieve Goal	Lead Cleanup Goal	Lead Achieve Goal	Manganese Cleanup Goal	Manganese Achieve Goal	Zinc Cleanup Goal	Zinc Achieve Goal
Human Risk:													
Water Ingestion/Fish Ingestion Pathway (ug/l)	HQ=1	36.7	Yes					165	Yes	33.7	No		
	Carc. 1E-06	0.158	No										
	Carc. 1E-05	1.58	No										
	Carc. 1E-04	15.8	Yes										
Soil Ingestion/Dust Inhalation Pathway (mg/Kg)	HQ=1	323	Yes					2200	Yes	1330	No		
	Carc. 1E-06	1.39	No										
	Carc. 1E-05	13.9	No										
	Carc. 1E-04	139	No										
Ecological Risk Scenario:	EQ=1												
Deer - Tailings Salt Ingestion (mg/Kg)	LOAEL	NA		NA		NA		314	No	NA		NA	
Plant Phytotoxicity - Soil (mg/Kg)	Max Phytotox.	50	No	8	No	125	No	400	No	3000	Yes	400	No
Aquatic Life - Water (ug/l)	AALS	340	Yes	2.1	Yes	14	Yes	81.6	Yes	NA		120	Yes
Aquatic Life - Sediment (mg/Kg)	PSQC	85	Yes	9	Yes	390	Yes	110	No	NA		270	No

Notes: NA - Not Applicable

LOAEL - Lower observed adverse effect level

AALS - Freshwater Acute Aquatic Life Standards (DEQ, 2002). Hardness = 100 mg/l $CaCO_3$ for hardness dependent elements.

PSQC - Proposed Sediment Quality Criteria

Table 8-4. Water Quality ARARs Attainment for Alternative 3

	Arsenic Cleanup Goal	Arsenic Achieve Goal	Cadmium Cleanup Goal	Cadmium Achieve Goal	Copper Cleanup Goal	Copper Achieve Goal	Lead Cleanup Goal	Lead Achieve Goal	Manganese Cleanup Goal	Manganese Achieve Goal	Zinc Cleanup Goal	Zinc Achieve Goal
Drinking Water MCL/HHS	18	Yes	5	Yes	1300	Yes	15	Yes	50	No	2000	Yes
Aquatic Life CALS	150	Yes	0.27	Unk	9.3	Unk	3.2	No	NA		119.8	Yes

HHS - Human Health Standards for Surface Water (DEQ, 2002)

MCL - Maximum Contaminant Level Drinking Water Regulations and Health Advisories, (EPA, 1993)

CALS - Freshwater Chronic Aquatic Life Standards (DEQ, 2002)

Water concentrations in ug/L.

CALS based on water hardness of 100 mg/L.

Unk - Unknown. Cleanup goal is less than the detection limit.

on the assumption that elevated levels of these contaminants in surface water are attributed to the presence of contaminated sediments in the unnamed tributary to Dog Creek and that sediments will eventually be sufficiently diluted such that they do not cause significant metals loading to Dog Creek. Implementation of this alternative will prevent further contact of the stream with waste rock and will reduce the erosion of contaminated sediments into the unnamed tributary. Drinking water MCLs and/or HHS for manganese and ambient water quality criteria for lead are not achieved under this alternative. Background water quality exceeds MCLs and/or HHS for manganese and exceeds CALS for lead. However, cleanup below background concentrations is not considered achievable. Ambient water quality standards for cadmium and copper may be achieved; however, this is unknown because the laboratory detection limit for these elements was greater than the water quality standard.

Cadmium, manganese and zinc exceed Federal MCLs or Montana HHS criteria and cadmium, copper and zinc exceed acute and chronic and lead exceeds chronic aquatic life standards in the discharge from the adit at waste rock pile WR1A. Under this alternative, it is proposed that the adit discharge be collected and discharged to a subsurface infiltration gallery. The adit discharge currently flows into the unnamed tributary to Dog Creek and flows over waste rock pile WR1A. Subsurface disposal of the adit discharge will effectively eliminate the direct exposure pathway under a recreational risk scenario (i.e., hikers, etc. drinking directly from the adit). However, this scenario is not necessarily protective of ground water resources. Ground water was not characterized during the site characterization.

Location-specific ARARs are expected to be met in the implementation of this alternative. Contacts with the appropriate agencies and acquisition of required permits related to streambeds, floodplains, and archaeological/paleontological resources would be completed.

Action-specific ARARs are expected to be met including the hydrological regulations contained in the Strip and Underground Mine Reclamation Act. The waste rock materials of concern are derived from the beneficiation and extraction of ores and are therefore exempt from federal regulation under the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. 6921 (b) (3) (A)(iii)(1994) as a hazardous waste. Mine and mill wastes are also excluded under the Montana Solid Waste Management Act (75-10-214 (1)(b) MCA. Any temporary stream diversions for construction activities will require coordination with the Montana Department of Fish, Wildlife, and Parks, The U.S. Army Corps of Engineers, the Montana Department of Natural Resources and Conservation, and the Lewis & Clark County Conservation District. Revegetation requirements contained in the Surface Mining and Control Reclamation Act would not be met because the waste rock piles would be left unvegetated. State of Montana air quality regulations related to dust suppression and control during construction activities will be met using water sprays where applicable, i.e. excavation areas in the waste rock and haul roads with heavy vehicular traffic.

Occupational Safety and Health Administration (OSHA) requirements would be met by requiring appropriate safety training for all on-site workers during the construction phase. Site activities would be conducted under the guidance of a Health and Safety Plan for the site as per OSHA 29 CFR 1910.120. Site personnel will have completed 40-hour hazardous waste operations and emergency response training and would be current on the 8-hour annual refresher training as required by OSHA.

8.2.3 Long-Term Effectiveness and Permanence

The waste rock piles have been in place for 50 to more than 100 years. The piles show no evidence of significant erosion or instability problems other than where the unnamed tributary to Dog Creek flows over the crest of waste rock pile WR1A. This portion of the pile would be removed and the stream reconstructed so that it is no longer in contact with the waste rock pile. Since the piles are similar to natural talus slopes, they are armored from erosion and have remained stable since their original placement several decades ago.

8.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Reduction of contaminant mobility by controlling exposure pathways is the primary objective of this alternative. The volume or toxicity of the contaminants in the waste rock would not be physically nor chemically reduced. Isolation of the stream from the waste rock piles would reduce the contaminant mobility by reducing the potential for erosion and leaching of metals.

8.2.5 Short-Term Effectiveness

It is anticipated that construction activities related to the implementation of this alternative would be completed in a relatively short time frame, i.e., a single construction season. Therefore, impacts associated with construction activities would be considered short term and should not significantly impact human health nor the environment. On-site workers would be protected by following a site specific Health and Safety Plan, employing appropriate personal protective equipment and by following proper operating and safety procedures. However, short term air quality impacts to the immediate environment may occur during the limited removal of waste rock pile WR3A removal and grading of a portion WR1A. Control of fugitive dust may require the use of water sprays. Short-term impacts to the surrounding community are expected to be minimal due to the location of the project site. The only foreseen short-term impact to the surrounding community would involve increased vehicle traffic, with associated safety hazards and dust generation, on the roads in the vicinity of the waste rock piles and repository area.

8.2.6 Implementability

The alternative is both technically and administratively feasible. The limited removal and grading associated with the reclamation are considered conventional construction practices. Design methods and requirements are generally well documented. Materials and construction equipment should be readily available, however, the construction is complicated by the steep terrain, which will require consideration in both the design and implementation of alternative.

8.2.7 Costs

The total present worth cost for reclamation by partial in-place containment of Devon/Sterling and Albion Waste Rock is estimated at $230,662. Table 8-5 presents the cost details associated with implementing this alternative. The total cost includes the present-worth value of 30 years of annual maintenance and monitoring costs in addition to capital costs. These costs assume that this alternative would be implemented in conjunction with Alternative 4a, 4b or 4c, and the costs for repository construction are included under the Alternative 4 options.

Table 8-5. Preliminary Cost Estimate for Alternative 3: Partial In-Place Containment of Devon/Sterling and Albion Waste Rock

Task	Quantity	Units	Unit $	Cost $	Comment
Mobilization, Bonding & Insurance	1	L.S.	11,958	$11,958	8%
Logistics					
Access Road Improvements	7500	LF	1.00	$7,500	
Site Clearing/Preparation	1.13	Ac	2,000	$2,260	
Debris Removal and Onsite Disposal	1	LS	5,000	$5,000	
Adit Water Infiltration Gallery	1	LS	10,000	$10,000	
In-Place Containment					
Remove WR3A	380	CY	7.00	$2,660	
Partial Remove/Grade WR1A	6,310	CY	7.00	$44,170	
Grading/Compaction (in repository)	6,690	CY	2.00	$13,380	
Stream Channel Reconstruction	600	LF	80.00	$48,000	
Water Diversion/Runon Controls					
Run-on Control Ditch	1,000	LF	2.00	$2,000	
Revegetation					
Seed/Fertilize	1.13	Ac	1,000	$1,130	
Mulch	1.13	Ac	1,000	$1,130	
Fencing					
Barbed-wire Fence	4,900	LF	2.50	$12,250	
Subtotal				$161,438	
Construction Oversight	15%			$24,216	
Subtotal Capital Costs				$185,654	
Contingency	10%			$18,565	
TOTAL CAPITAL COSTS				$204,219	
POST CLOSURE MONITORING AND MAINTENANCE COSTS					
Inspections	1	/Year	250	$250	
Sampling & Analysis	4	/Year	200	$800	
Maintenance	1	L.S.	1500	$1,500	
Subtotal				$2,550	
Contingency	10%			$255	
TOTAL ANNUAL O&M COST				$2,805	
TOTAL CAPITAL COSTS				$204,219	
PRESENT WORTH O&M COST	30	yrs @	10%	$26,442	
TOTAL PRESENT WORTH COST				$230,662	

The general construction steps for implementing Alternative 3, are as follows:

- removal of waste rock pile WR3A to a mine/mill waste repository (constructed as part of Alternative 4);
- removal of a portion of waste rock pile WR1A to a mine/mill waste repository (constructed as part of Alternative 4) to allow reconstruction of the unnamed tributary to Dog Creek;
- reconstruction of the unnamed tributary of Dog Creek through a portion waste rock pile WR1A;
- diversion of adit discharge water to a subsurface infiltration gallery to eliminate exposure by direct contact;
- constructing surface water diversion ditches strategically located to control water runon in the vicinity of the waste removal areas during revegetation;
- establishing vegetation on the waste removal areas by seeding and fertilizing;
- mulching of the seeded areas; and
- constructing a 4-strand, barbed-wire fence around the perimeter of the reclaimed waste piles.

8.3 ALTERNATIVE 4a: ON-SITE DISPOSAL OF TAILINGS AND SELECTED WASTE ROCK IN A CONSTRUCTED RCRA REPOSITORY

The reclamation strategy for Alternative 4a involves removing the mill tailings sources from tailings piles TP-1, TP-2, TP-3, TP-4 (and the Vat Leach area), TP-5, TP-6; waste rock sources from piles WR-1, WR-2, WR-3 and WR-4; the Dog Creek floodplain tailings; and impacted native soil from beneath TP-1, TP-2, TP-4, TP-5, TP-6, and disposing these wastes in a constructed repository which complies with RCRA Subtitle C regulations for hazardous waste landfill closures (Figure 7-1). The only exception to the RCRA Subtitle C regulations would be the use of a GCL in place of a compacted clay liner. This is based on the site characterization results, which did not reveal the presence of a clay borrow source in the vicinity of the site. The repository would consist of a composite, double-lined leachate collection and removal system underlying the waste in conjunction with a composite, multi-layered, lined cap overlying the waste. Assuming that the tailings, selected waste rock and impacted soil volume was deposited in an area of approximately 4.39 acres, the total height of the repository would be approximately 54 feet, with a maximum waste thickness of approximately 36 feet, in order to achieve a 3:1 side slope design in the final cap.

WR3A and a portion of WR1A removed under Alternative 3 may also be placed in the repository (if Alternative 3 is implemented). The repository is designed to accommodate the waste from Alternative 3; however, the costs for removal and transportation of these wastes are included under Alternative 3.

The HELP model was used to simulate the RCRA Subtitle C repository scenario. Based on representative soil properties for the 1.5-foot cover soil, gravel drainage layer, 20-mil flexible membrane liner, geosynthetic clay liner (substituted for the compacted clay liner), an average of

14.5 feet of mine/mill waste, a gravel primary leachate collection/removal layer, 30-mil flexible membrane liner, a gravel secondary leachate collection/removal layer, a 30-mil flexible membrane liner and a geosynthetic clay liner (substituted for the compacted clay liner), the predicted infiltration of water through the repository base liner system is an average of 0.00000 inches per year over a 30-year period. An average of 14.499 inches of water per year is predicted to be lost through evapotranspiration, which is equivalent to 90.938 percent of the average annual precipitation of 15.94 inches. Surface water runoff accounts for a loss of 1.196 inches per year or 7.500 percent of precipitation. Lateral drainage from the geocomposite drainage layer accounts for a loss of 0.160 inches of water per year or 1.001 percent of precipitation. The remaining 0.561 percent of precipitation is accounted for by changes in water storage in the cover soil and tailings layers.

8.3.1 Overall Protection of Human Health and the Environment

This alternative provides control of direct exposure to the contaminated materials and reduction in risk to human health and the environment. It prevents further erosion and migration of contaminants from tailings source areas and waste rock from the Bald Butte Millsite area. Existing sediment in Dog Creek is not removed in this alternative, however, existing stream sediments should be diluted by mixing with natural sediment or through bedload dispersion downstream to achieve risk-based cleanup goals based on existing background levels.

Placing the wastes into a repository would prevent exposure by direct contact. Exposure to arsenic and lead via ingestion of water/fish is expected to be reduced to below risk-based cleanup goals since further erosion of contaminated sediments into Dog Creek would be prevented. Manganese exposure via the fish ingestion pathway would be reduced to levels consistent with background water quality, but would not achieve risk-based cleanup goals. Cleanup below background concentrations is not considered achievable. Carcinogenic risk from ingestion of arsenic via ingestion of water/fish would not be reduced to 1E-06.

Soil ingestion/dust inhalation of arsenic, lead and manganese would be reduced to below risk-based cleanup goals. Carcinogenic risk from soil ingestion/dust inhalation of arsenic would not be reduced to 1E-06.

Protection of the environment would generally be achieved under this alternative. Prevention of ecological exposures via exposure to water, sediment, and soil sources would be achieved to the extent practicable: deer exposure to lead via ingestion of tailings salts; plant phytotoxicity to arsenic, cadmium, copper, lead, manganese and zinc; acute exposure of aquatic life to arsenic, cadmium, copper, lead and zinc via surface water; and aquatic life exposure to cadmium and zinc via sediment would be reduced to risk-based cleanup levels. Since the waste sources would be removed from the vicinity of Dog Creek, arsenic, lead and zinc concentrations in the stream sediment would be reduced to levels consistent with background as existing sediments are either diluted by mixing with natural sediment or through bedload dispersion downstream, however, these concentrations may not be reduced below risk-based cleanup goals. A risk reduction achievement matrix for the various pathways and contaminants, identified in the baseline human health risk assessment and the ecological risk assessment, is shown in Table 8-6.

Table 8-6. Risk Reduction Achievement Matrix for Alternative 4a

Exposure Pathway	Risk Level	Arsenic		Cadmium		Copper		Lead		Manganese		Zinc	
		Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal
Human Risk:													
Water Ingestion/Fish Ingestion Pathway (ug/l)	HQ=1	36.7	Yes					165	Yes	33.7	No		
	Carc. 1E-06	0.158	No										
	Carc. 1E-05	1.58	No										
	Carc. 1E-04	15.8	Yes										
Soil Ingestion/Dust Inhalation Pathway (mg/Kg)	HQ=1	323	Yes					2200	Yes	1330	Yes		
	Carc. 1E-06	1.39	No										
	Carc. 1E-05	13.9	No										
	Carc. 1E-04	139	Yes										
Ecological Risk Scenario:	EQ=1												
Deer - Tailings Salt Ingestion (mg/Kg)	LOAEL	NA		NA		NA		314	Yes	NA		NA	
Plant Phytotoxicity - Soil (mg/Kg)	Max Phytotox.	50	Yes	8	Yes	125	Yes	400	Yes	3000	Yes	400	Yes
Aquatic Life - Water (ug/l)	AALS	340	Yes	2.1	Yes	14	Yes	81.6	Yes	NA		120	Yes
Aquatic Life - Sediment (mg/Kg)	PSQC	85	No	9	Yes	390	Yes	110	No	NA		270	No

Notes: NA - Not Applicable

LOAEL - Lower observed adverse effect level

AALS - Freshwater Acute Aquatic Life Standards (DEQ, 2002). Hardness = 100 mg/l $CaCO_3$ for hardness dependent elements.

PSQC - Proposed Sediment Quality Criteria

Table 8-7. Water Quality ARARs Attainment for Alternative 4a

	Arsenic		Cadmium		Copper		Lead		Manganese		Zinc	
	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal
Drinking Water MCL/HHS	18	Yes	5	Yes	1300	Yes	15	Yes	50	No	2000	Yes
Aquatic Life CALS	150	Yes	0.27	Unk	9.3	Unk	3.2	No	NA		119.8	Yes

HHS - Human Health Standards for Surface Water (DEQ, 2002)

MCL - Maximum Contaminant Level Drinking Water Regulations and Health Advisories, (EPA, 1993)

CALS - Freshwater Chronic Aquatic Life Standards (DEQ, 2002)

Water concentrations in ug/L.

CALS based on water hardness of 100 mg/L.

Unk - Unknown. Cleanup goal is less than the detection limit.

8.3.2 Compliance with ARARs

With the exception of lead and manganese, contaminant-specific ARARs are expected to be met when implementing this alternative. Table 8-7 shows that drinking water MCLs and/or HHS for arsenic, cadmium, copper, lead and zinc and ambient water quality criteria for arsenic and zinc are achieved in Dog Creek under this alternative. This is based on the assumption that elevated levels of these contaminants in surface water are attributed to the presence of contaminated sediments in Dog Creek and that sediments will eventually be sufficiently diluted such that they do not cause significant metals loading to Dog Creek. Implementation of this alternative will prevent further erosion of tailings into Dog Creek. Drinking water MCLs and/or HHS for manganese and ambient water quality criteria for lead are not achieved under this alternative. Background water quality exceeds MCLs and/or HHS for manganese and exceeds CALS for lead. However, cleanup below background concentrations is not considered achievable. Ambient water quality standards for cadmium and copper may be achieved; however, this is unknown because the laboratory detection limit for these elements was greater than the water quality standard.

Implementation of this alternative is also expected to satisfy air quality regulations because the repository cap and vegetation cover would stabilize the contaminant sources and inhibit fugitive emissions. The tailings have the highest potential for fugitive emissions based on grain size.

Location-specific ARARs are expected to be met in the implementation of this alternative. Contacts with the appropriate agencies and acquisition of required permits related to streambeds, floodplains, and archaeological/paleontological resources would be completed.

Action-specific ARARs are expected to be met including the hydrological regulations contained in the Strip and Underground Mine Reclamation Act. The tailings and waste rock materials of concern are derived from the beneficiation and extraction of ores and are therefore exempt from federal regulation under the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. 6921 (b) (3) (A)(iii)(1994) as a hazardous waste. Mine and mill wastes are also excluded under the Montana Solid Waste Management Act (75-10-214 (1)(b) MCA. Any temporary stream diversions for construction activities will require coordination with the Montana Department of Fish, Wildlife, and Parks, The U.S. Army Corps of Engineers, the Montana Department of Natural Resources and Conservation, and the Lewis & Clark County Conservation District. Revegetation requirements contained in the Surface Mining and Control Reclamation Act would be met. State of Montana air quality regulations related to dust suppression and control during construction activities will be met using water sprays where applicable, i.e. excavation areas in the tailings and waste rock, and haul roads with heavy vehicular traffic.

Occupational Safety and Health Administration (OSHA) requirements would be met by requiring appropriate safety training for all on-site workers during the construction phase. Site activities would be conducted under the guidance of a Health and Safety Plan for the site as per OSHA 29 CFR 1910.120. Site personnel will have completed 40-hour hazardous waste operations and emergency response training and would be current on the 8-hour annual refresher training as required by OSHA.

8.3.3 Long-Term Effectiveness and Permanence

This alternative would reduce contaminant mobility at the site by removing the highest risk, solid media contaminant sources and disposing of these wastes in an engineered repository. The tailings, waste rock and impacted soil would be encapsulated in an engineered repository that would effectively isolate this waste and reduce contaminant mobility. Periodic inspections and maintenance would ensure the long-term stability of the repository.

8.3.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Reduction of contaminant mobility is the primary objective of this alternative. The volume or toxicity of the contaminants in the tailings and waste rock would not be physically nor chemically reduced. The excavation of the tailings and waste from the drainage area would reduce the contaminant mobility by moving the waste to a secure location. The primary waste sources of concern (tailings and waste rock piles) would be encapsulated in an engineered structure and physical location which is protected from erosion and water infiltration problems.

8.3.5 Short-Term Effectiveness

It is anticipated that construction activities related to the implementation of this alternative would be completed in one construction season. Impacts associated with construction activities would generally be less than 120 days and should not significantly impact human health nor the environment. On-site workers would be protected by following a site specific Health and Safety Plan, employing appropriate personal protective equipment and by following proper operating and safety procedures. However, short term air quality impacts to the immediate environment may occur due to the relatively large volume of waste excavation and hauling. Control of fugitive dust may require the use of water sprays. Short-term impacts to the surrounding community are expected to be minimal due to the location of the project site. The only foreseen short-term impact to the surrounding community would involve increased vehicle traffic, with associated safety hazards and dust generation, on roads in the vicinity of the waste sources and the repository.

8.3.6 Implementability

This alternative is both technically and administratively feasible. Waste removal, repository construction, and establishing vegetation are readily implementable using conventional construction techniques. Key project components, such as the availability of equipment, materials, and construction expertise, are present and would aid in the timely implementation and successful execution of the proposed project.

8.3.7 Costs

The total present-worth cost for this alternative has been estimated at $3,843,869 which represents the removal of the tailings, selected waste rock and impacted soil to a constructed unlined repository with a multi-layered cap. Table 8-8 presents the cost details associated with implementing this alternative. The total cost includes the present-worth value of 30 years of annual maintenance and monitoring costs in addition to capital costs.

Table 8-8. Preliminary Cost Estimate for Alternative 4a: On-Site Disposal of Tailings and Selected Waste Rock in a Constructed RCRA Repository

Task	Quantity	Units	Unit $	Cost $	Comment
Mobilization, Bonding & Insurance	1	L.S.	223,535	$223,535	8%
Logistics					
Access Road Improvements	15,500	LF	1.00	$15,500	
Site Clearing/Preparation	24.92	Ac	2,000	$49,840	
Dog Creek Stream Diversions	6,700	LF	25.00	$167,500	
Dewater Ponds	1	LS	10,000	$10,000	
Debris Removal and Onsite Disposal	1	LS	10,000	$10,000	
Repository Construction					
Cover Soil Removal and Stockpiling	10,840	CY	2.00	$21,680	
Repository Base Grading	4.39	Ac	2,000	$8,789	
Install Geotextile Cushion	21,280	SY	3.00	$63,840	
Geosynthetic Clay Liner	21,280	SY	4.50	$95,760	
Install 30 mil Flexible Membrane Liner	21,280	SY	6.00	$127,680	
Gravel Drainage Layer	7,100	CY	20.00	$142,000	
Install 30 mil Flexible Membrane Liner	21,280	SY	6.00	$127,680	
Gravel Drainage Layer	7,100	CY	20.00	$142,000	
Geotextile Filter Fabric	21,280	SY	3.00	$63,840	
Leachate Collection System	1	LS	10,000	$10,000	
Waste Load, Haul & Dump					
Tailings	70,650	CY	4.00	$282,600	
Dog Creek Floodplain Tailings	7,510	CY	6.00	$45,060	
Impacted Soil	33,830	CY	4.00	$135,320	
Bald Butte Waste Rock	2,874	CY	4.00	$11,496	
Waste Grading and Compaction	114,864	CY	2.00	$229,728	
Repository Cap Construction					
Install Geotextile Cushion	21,680	SY	3.00	$65,040	
Geosynthetic Clay Liner	21,680	SY	4.50	$97,560	
Install 20 mil Flexible Membrane Liner	21,680	SY	5.00	$108,400	
Geocomposite Drainage Layer	21,680	SY	4.50	$97,560	
Cover Soil	10,840	CY	2.00	$21,680	
Stream Channel Reconstruction	6,500	LF	80.00	$520,000	
Water Diversion/Runon Controls					
Run-on Control Ditch	1,000	LF	2.00	$2,000	
Grade Native Soil Dams	7,200	LF	2.00	$14,400	
Revegetation					
Seed/Fertilize	24.92	Ac	1,000	$24,920	
Mulch	24.92	Ac	1,000	$24,920	
Fencing					
Barbed-wire Fence	17,200	LF	2.50	$43,000	
Repository Fence	2,400	LF	6.00	$14,400	
Subtotal				$3,017,728	
Construction Oversight	15%			$452,659	
Subtotal Capital Costs				$3,470,388	
Contingency	10%			$347,039	
TOTAL CAPITAL COSTS				$3,817,426	
POST CLOSURE MONITORING AND MAINTENANCE COSTS					
Inspections	1	/Year	250	$250	
Sampling & Analysis	4	/Year	200	$800	
Maintenance	1	L.S.	1500	$1,500	
Subtotal				$2,550	
Contingency	10%			$255	
TOTAL ANNUAL O&M COST				$2,805	
TOTAL CAPITAL COSTS				$3,817,426	
PRESENT WORTH O&M COST	30	yrs @	10%	$26,442	
TOTAL PRESENT WORTH COST				$3,843,869	

Conceptual Design and Assumptions

The repository area was selected largely because it is one of the only areas in the vicinity of the project that is relatively open and flat. The base of the repository would be constructed on a bench above Dog Creek, and keyed into the hillside to the east. This area comprises roughly 5 acres that appear to be appropriate for the construction of a repository. The proposed repository site is located on a narrow bench above Dog Creek, and would be constructed against the existing hillside on the east side of Dog Creek. The repository area has been logged in the past and has abundant tree stumps that would require removal prior to installation of the base liners and leachate collection system.

A considerable amount of heavy equipment/machinery would be necessary to efficiently implement these alternatives. To construct the repository and load out the waste material, as well as construct runon/runoff control structures, equipment requirements would include, but not be limited to, multiple bulldozers, front end loaders and excavators. Haul trucks or scrapers would also be required to transport and deposit the contaminated material in the constructed repository. The field procedure would involve improving the existing roads from the tailings and waste rock pile areas to the repository area to a one lane haul road with turnouts to allow unobstructed access for heavy equipment. The number of loaders, haul trucks and/or scrapers would be maximized to the extent possible to reduce the overall time required to complete the project's construction phase.

Removal of the Bald Butte millsite tailings and impacted soils would require the construction of temporary diversions of Dog Creek around tailings piles TP-1, TP-2 and TP-3; tailings pile TP-5; and tailings pile TP-6 to facilitate the removal of tailings. After the repository construction, waste excavation, and waste placement are complete, the excavated areas would be revegetated. Cover/fill soil may be required in the excavated areas to level and contour the areas to match the surrounding terrain. It is assumed that soil from the repository excavation would be stockpiled and used for cover soil on the repository. Native soil from the TP-1 and TP-2 dams would be graded onto the excavation source areas prior to revegetation. It is possible that a pond could be reconstructed in the area of the existing Pond 2 (Figure 3-2) to continue the current level of recreational opportunities. If a pond is reconstructed, the native soil from the TP-1 and TP-2 dams would be used to construct the pond dam.

The seed beds would be prepared using conventional agricultural plowing. Seeding would likely take place during the fall of the year. The seed mixture and fertilizer would be applied simultaneously to the prepared seed beds via drill application. Mulch would be applied to promote temporary protection of exposed erodible surfaces. Wheat or barley straw mulch (certified weed-free) would be applied over the excavated areas and the repository cap with a tow spreader or pneumatic spreader utilizing tucking/crimping as the anchoring mechanism. A runon/runoff control ditch would be constructed in the area of the repository to divert runoff away from the repository cap. Barbed-wire fencing would be placed around the excavated waste source areas to allow the establishment of vegetation without interference from livestock. A woven-wire fence would be constructed around the repository to limit access.

The general construction steps for implementing Alternative 4a are as follows:

- improving access roads from the waste source areas to the repository;
- site clearing, preparation and debris removal;

- dewatering of the two ponds in the vicinity of tailings pile TP-1 to facility tailings removal and site reclamation;
- preparation of the repository base, including tree, stump and rock removal and recovery and stockpiling of cover soil;
- placement of the repository base liner and leachate collection system;
- excavation, loading, hauling, placement, grading and compaction of tailings from tailings piles TP-1 through TP-6;
- excavation, loading, hauling, placement, grading and compaction of impacted native soils from beneath tailings area;
- excavation, loading, hauling, placement, grading and compaction of waste rock from waste rock piles WR-1 through WR-4;
- installation of the cap liners and geocomposite drainage layer;
- placement and grading of stockpiled cover soil on the repository;
- constructing surface water diversion ditches strategically located to control water runon in the vicinity of the repository;
- reconstruction of the Dog Creek stream channel in the vicinity of tailings piles TP-1 through TP-6.
- grading of native soil from the TP-1 and TP-2 dams onto the excavated source areas;
- establishing vegetation on the repository and excavated waste area by seeding and fertilizing;
- mulching of the seeded areas;
- constructing a 4-strand, barbed-wire fence around the perimeter of the excavated source areas; and
- construction of a woven-wire fence around the repository.

8.4 ALTERNATIVE 4b: ON-SITE DISPOSAL OF TAILINGS AND SELECTED WASTE ROCK IN A CONSTRUCTED MODIFIED RCRA REPOSITORY

The reclamation strategy for Alternative 4b involves removing the mill tailings sources from tailings piles TP-1, TP-2, TP-3, TP-4 (and the vat leach area), TP-5, TP-6; waste rock sources from piles WR-1, WR-2, WR-3 and WR-4; the Dog Creek floodplain tailings; and impacted native soil from beneath TP-1, TP-2, TP-4, TP-5, TP-6, and disposing these wastes in a constructed modified RCRA repository which includes a single GCL base liner (without a leachate collection and removal system) and a multi-layered cap. The repository would consist of a geosynthetic clay liner underlying the waste in conjunction with a composite, multi-layered, lined cap overlying the waste. Assuming that the tailings, selected waste rock and impacted soils volume was deposited in an area of approximately 4.39 acres, the total height of the repository would be approximately 54 feet, with a maximum waste thickness of approximately 36 feet, in order to achieve a 3:1 side slope design in the final cap.

WR3A and a portion of WR1A removed under Alternative 3 may also be placed in the repository (if Alternative 3 is implemented). The repository is designed to accommodate the waste from Alternative 3; however, the costs for removal and transportation of these wastes are included under Alternative 3.

The HELP model was used to simulate the modified RCRA repository scenario. Based on representative soil properties for the 1.5-foot cover soil, geocomposite drainage layer, geosynthetic clay liner, an average of 14.5 feet of mine/mill waste and a base geosynthetic clay liner, the predicted infiltration of water through the repository base liner system is an average of 0.00000 inches per year over a 30-year period. An average of 14.499 inches of water per year is predicted to be lost through evapotranspiration, which is equivalent to 90.938 percent of the average annual precipitation of 15.94 inches. Surface water runoff accounts for a loss of 1.196 inches per year or 7.500 percent of precipitation. Lateral drainage from the geocomposite drainage layer accounts for a loss of 0.160 inches of water per year or 1.001 percent of precipitation. The remaining 0.561 percent of precipitation is accounted for by changes in water storage in the cover soil and tailings layers.

8.4.1 Overall Protection of Human Health and the Environment

This alternative provides control of direct exposure to the contaminated materials and reduction in risk to human health and the environment. It prevents further erosion and migration of contaminants from tailings source areas and waste rock from the Bald Butte Millsite area. Existing sediment in Dog Creek is not removed in this alternative, however, existing stream sediments should be diluted by mixing with natural sediment or through bedload dispersion downstream to achieve risk-based cleanup goals based on existing background levels.

Placing the wastes into a repository would prevent exposure by direct contact. Exposure to arsenic and lead via ingestion of water/fish is expected to be reduced to below risk-based cleanup goals since further erosion of contaminated sediments into Dog Creek would be prevented. Manganese exposure via the fish ingestion pathway would be reduced to levels consistent with background water quality, but would not achieve risk-based cleanup goals. Cleanup below background concentrations is not considered achievable. Carcinogenic risk from ingestion of arsenic via ingestion of water/fish would not be reduced to 1E-06.

Soil ingestion/dust inhalation of arsenic, lead and manganese would be reduced to below risk-based cleanup goals. Carcinogenic risk from soil ingestion/dust inhalation of arsenic would not be reduced to 1E-06.

Protection of the environment would generally be achieved under this alternative. Prevention of ecological exposures via exposure to water, sediment, and soil sources would be achieved to the extent practicable: deer exposure to lead via ingestion of tailings salts; plant phytotoxicity to arsenic, cadmium, copper, lead, manganese and zinc; acute exposure of aquatic life to arsenic, cadmium, copper, lead and zinc via surface water; and aquatic life exposure to cadmium and zinc via sediment would be reduced to risk-based cleanup levels. Since the waste sources would be removed from the vicinity of Dog Creek, arsenic, lead and zinc concentrations in the stream sediment would be reduced to levels consistent with background as existing sediments are either diluted by mixing with natural sediment or through bedload dispersion downstream, however, these concentrations may not be reduced below risk-based cleanup goals. A risk reduction achievement matrix for the various pathways and contaminants, identified in the baseline human health risk assessment and the ecological risk assessment, is shown in Table 8-9.

8.4.2 Compliance with ARARs

With the exception of lead and manganese, contaminant-specific ARARs are expected to be met when implementing this alternative. Table 8-10 shows that drinking water MCLs and/or HHS for arsenic, cadmium, copper, lead and zinc and ambient water quality criteria for arsenic and zinc are achieved in Dog Creek under this alternative. This is based on the assumption that elevated levels of these contaminants in surface water are attributed to the presence of contaminated sediments in Dog Creek and that sediments will eventually be sufficiently diluted such that they do not cause significant metals loading to Dog Creek. Implementation of this alternative will prevent further erosion of tailings into Dog Creek. Drinking water MCLs and/or HHS for manganese and ambient water quality criteria for lead are not achieved under this alternative. Background water quality exceeds MCLs and/or HHS for manganese and exceeds CALS for lead. However, cleanup below background concentrations is not considered achievable. Ambient water quality standards for cadmium and copper may be achieved; however, this is unknown because the laboratory detection limit for these elements was greater than the water quality standard.

Implementation of this alternative is also expected to satisfy air quality regulations because the repository cap and vegetation cover would stabilize the contaminant sources and inhibit fugitive emissions. The tailings have the highest potential for fugitive emissions based on grain size.

Location-specific ARARs are expected to be met in the implementation of this alternative. Contacts with the appropriate agencies and acquisition of required permits related to streambeds, floodplains, and archaeological/paleontological resources would be completed.

Action-specific ARARs are expected to be met including the hydrological regulations contained in the Strip and Underground Mine Reclamation Act. The tailings and waste rock materials of concern are derived from the beneficiation and extraction of ores and are therefore exempt from federal regulation under the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. 6921 (b) (3) (A)(iii)(1994) as a hazardous waste. Mine and mill wastes are also excluded under the Montana Solid Waste Management Act (75-10-214 (1)(b) MCA. Any temporary stream diversions for construction activities will require coordination with the Montana Department of Fish, Wildlife, and Parks, The U.S. Army Corps of Engineers, the Montana Department of Natural Resources and Conservation, and the Lewis & Clark County Conservation District. Revegetation requirements contained in the Surface Mining and Control Reclamation Act would be met. State of Montana air quality regulations related to dust suppression and control during construction activities will be met using water sprays where applicable, i.e. excavation areas in the tailings and waste rock, and haul roads with heavy vehicular traffic.

Occupational Safety and Health Administration (OSHA) requirements would be met by requiring appropriate safety training for all on-site workers during the construction phase. Site activities would be conducted under the guidance of a Health and Safety Plan for the site as per OSHA

Table 8-9. Risk Reduction Achievement Matrix for Alternative 4b

		Arsenic		Cadmium		Copper		Lead		Manganese		Zinc	
Exposure Pathway	Risk Level	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal
Human Risk:													
Water Ingestion/Fish Ingestion Pathway (ug/l)	HQ=1	36.7	Yes					165	Yes	33.7	No		
	Carc. 1E-06	0.158	No										
	Carc. 1E-05	1.58	No										
	Carc. 1E-04	15.8	Yes										
Soil Ingestion/Dust Inhalation Pathway (mg/Kg)	HQ=1	323	Yes					2200	Yes	1330	Yes		
	Carc. 1E-06	1.39	No										
	Carc. 1E-05	13.9	No										
	Carc. 1E-04	139	Yes										
Ecological Risk Scenario:	EQ=1												
Deer - Tailings Salt Ingestion (mg/Kg)	LOAEL	NA		NA		NA		314	Yes	NA		NA	
Plant Phytotoxicity - Soil (mg/Kg)	Max Phytotox.	50	Yes	8	Yes	125	Yes	400	Yes	3000	Yes	400	Yes
Aquatic Life - Water (ug/l)	AALS	340	Yes	2.1	Yes	14	Yes	81.6	Yes	NA		120	Yes
Aquatic Life - Sediment (mg/Kg)	PSQC	85	No	9	Yes	390	Yes	110	No	NA		270	No

Notes: NA - Not Applicable

LOAEL - Lower observed adverse effect level

AALS - Freshwater Acute Aquatic Life Standards (DEQ, 2002). Hardness = 100 mg/l $CaCO_3$ for hardness dependent elements.

PSQC - Proposed Sediment Quality Criteria

Table 8-10. Water Quality ARARs Attainment for Alternative 4b

	Arsenic		Cadmium		Copper		Lead		Manganese		Zinc	
	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal
Drinking Water MCL/HHS	18	Yes	5	Yes	1300	Yes	15	Yes	50	No	2000	Yes
Aquatic Life CALS	150	Yes	0.27	Unk	9.3	Unk	3.2	No	NA		119.8	Yes

HHS - Human Health Standards for Surface Water (DEQ, 2002)

MCL - Maximum Contaminant Level Drinking Water Regulations and Health Advisories, (EPA, 1993)

CALS - Freshwater Chronic Aquatic Life Standards (DEQ, 2002)

Water concentrations in ug/L.

CALS based on water hardness of 100 mg/L.

Unk - Unknown. Cleanup goal is less than the detection limit.

29 CFR 1910.120. Site personnel will have completed 40-hour hazardous waste operations and emergency response training and would be current on the 8-hour annual refresher training as required by OSHA.

8.4.3 Long-Term Effectiveness and Permanence

This alternative would reduce contaminant mobility at the site by removing the highest risk, solid media contaminant sources and disposing of these wastes in an engineered repository. The tailings, waste rock and impacted soil would be encapsulated in an engineered repository that would effectively isolate this waste and reduce contaminant mobility. Periodic inspections and maintenance would ensure the long-term stability of the repository.

8.4.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Reduction of contaminant mobility is the primary objective of this alternative. The volume or toxicity of the contaminants in the tailings and waste rock would not be physically nor chemically reduced. The excavation of the tailings from the drainage area would reduce the contaminant mobility by moving the waste to a secure location. The primary waste sources of concern (tailings and waste rock piles) would be encapsulated in an engineered structure and physical location which is protected from erosion and water infiltration problems.

8.4.5 Short-Term Effectiveness

It is anticipated that construction activities related to the implementation of this alternative would be completed in one construction season. Impacts associated with construction activities would generally be less than 120 days and should not significantly impact human health nor the environment. On-site workers would be protected by following a site specific Health and Safety Plan, employing appropriate personal protective equipment and by following proper operating and safety procedures. However, short term air quality impacts to the immediate environment may occur due to the relatively large volume of waste excavation and hauling. Control of fugitive dust may require the use of water sprays. Short-term impacts to the surrounding community are expected to be minimal due to the location of the project site. The only foreseen short-term impact to the surrounding community would involve increased vehicle traffic, with associated safety hazards and dust generation, on roads in the vicinity of the waste sources and the repository.

8.4.6 Implementability

This alternative is both technically and administratively feasible. Waste removal, repository construction, and establishing vegetation are readily implementable using conventional construction techniques. Key project components, such as the availability of equipment, materials, and construction expertise, are present and would aid in the timely implementation and successful execution of the proposed project.

8.4.7 Costs

The total present-worth cost for this alternative has been estimated at $2,858,019 which represents the removal of the tailings, selected waste rock and impacted soil to a constructed modified RCRA repository. Table 8-11 presents the cost details associated with implementing this alternative. The total cost includes the present-worth value of 30 years of annual maintenance and monitoring costs in addition to capital costs.

Conceptual Design and Assumptions

The repository area was selected largely because it is one of the only areas in the vicinity of the project that is relatively open and flat. The base of the repository would be constructed on a bench above Dog Creek, and keyed into the hillside to the east. This area comprises roughly 5 acres that appear to be appropriate for the construction of a repository. The proposed repository site is located on a narrow bench above Dog Creek, and would be constructed against the existing hillside on the east side of Dog Creek. The repository area has been logged in the past and has abundant tree stumps that would require removal prior to installation of the base GCL liner.

A considerable amount of heavy equipment/machinery would be necessary to efficiently implement these alternatives. To construct the repository and load out the waste material, as well as construct runon/runoff control structures, equipment requirements would include, but not be limited to, multiple bulldozers, front end loaders and excavators. Haul trucks or scrapers would also be required to transport and deposit the contaminated material in the constructed repository. The field procedure would involve improving the existing roads from the tailings and waste rock pile areas to the repository area to a one lane haul road with turnouts to allow unobstructed access for heavy equipment. The number of loaders, haul trucks and/or scrapers would be maximized to the extent possible to reduce the overall time required to complete the project's construction phase.

Removal of the Bald Butte millsite tailings and impacted soils would require the construction of temporary diversions of Dog Creek around tailings piles TP-1, TP-2 and TP-3; tailings pile TP-5; and tailings pile TP-6 to facilitate the removal of tailings. After the repository construction, waste excavation, and waste placement are complete, the excavated areas would be revegetated. Cover/fill soil may be required in the excavated areas to level and contour the areas to match the surrounding terrain. It is assumed that soil from the repository excavation would be stockpiled and used for cover soil on the repository. Native soil from the TP-1 and TP-2 dams would be graded onto the excavation source areas prior to revegetation. It is possible that a pond could be reconstructed in the area of the existing Pond 2 (Figure 3-2) to continue the current level of recreational opportunities. If a pond is reconstructed, the native soil from the TP-1 and TP-2 dams would be used to construct the pond dam.

The seed beds would be prepared using conventional agricultural plowing. Seeding would likely take place during the fall of the year. The seed mixture and fertilizer would be applied simultaneously to the prepared seed beds via drill application. Mulch would be applied to promote temporary protection of exposed erodible surfaces. Wheat or barley straw mulch (certified weed-free) would be applied over the excavated areas and the repository cap with a tow spreader or pneumatic spreader utilizing tucking/crimping as the anchoring mechanism. A runon/runoff control ditch would be constructed in the area of the repository to divert runoff away

Table 8-11. Preliminary Cost Estimate for Alternative 4b: On-Site Disposal of Tailings and Selected Waste Rock in a Constructed Modified RCRA Repository

Task	Quantity	Units	Unit $	Cost $	Comment
Mobilization, Bonding & Insurance	1	L.S.	165,807	$165,807	8%
Logistics					
Access Road Improvements	15,500	LF	1.00	$15,500	
Site Clearing/Preparation	24.92	Ac	2,000	$49,840	
Dog Creek Stream Diversions	6,700	LF	25.00	$167,500	
Dewater Ponds	1	LS	10,000	$10,000	
Debris Removal and Onsite Disposal	1	LS	10,000	$10,000	
Repository Construction					
Cover Soil Removal and Stockpiling	10,840	CY	2.00	$21,680	
Repository Base Grading	4.39	Ac	2,000	$8,789	
Install Geotextile Cushion	21,280	SY	3.00	$63,840	
Geosynthetic Clay Liner	21,280	SY	4.50	$95,760	
Waste Load, Haul & Dump					
Tailings	70,650	CY	4.00	$282,600	
Dog Creek Floodplain Tailings	7,510	CY	6.00	$45,060	
Impacted Soil	33,830	CY	4.00	$135,320	
Bald Butte Waste Rock	2,874	CY	4.00	$11,496	
Waste Grading and Compaction	114,864	CY	2.00	$229,728	
Repository Cap Construction					
Install Geotextile Cushion	21,680	SY	3.00	$65,040	
Geosynthetic Clay Liner	21,680	SY	4.50	$97,560	
Geocomposite Drainage Layer	21,680	SY	4.50	$97,560	
Cover Soil	10,840	CY	2.00	$21,680	
Stream Channel Reconstruction	6,500	LF	80.00	$520,000	
Water Diversion/Runon Controls					
Run-on Control Ditch	1,000	LF	2.00	$2,000	
Grade Native Soil Dams	7,200	CY	2.00	$14,400	
Revegetation					
Seed/Fertilize	24.92	Ac	1,000	$24,920	
Mulch	24.92	Ac	1,000	$24,920	
Fencing					
Barbed-wire Fence	17,200	LF	2.50	$43,000	
Repository Fence	2,400	LF	6.00	$14,400	
Subtotal				$2,238,400	
Construction Oversight	15%			$335,760	
Subtotal Capital Costs				$2,574,160	
Contingency	10%			$257,416	
TOTAL CAPITAL COSTS				$2,831,576	
POST CLOSURE MONITORING AND MAINTENANCE COSTS					
Inspections	1	/Year	250	$250	
Sampling & Analysis	4	/Year	200	$800	
Maintenance	1	L.S.	1500	$1,500	
Subtotal				$2,550	
Contingency	10%			$255	
TOTAL ANNUAL O&M COST				$2,805	
TOTAL CAPITAL COSTS				$2,831,576	
PRESENT WORTH O&M COST	30	yrs @	10%	$26,442	
TOTAL PRESENT WORTH COST				$2,858,019	

from the repository cap. Barbed-wire fencing would be placed around the excavated waste source areas to allow the establishment of vegetation without interference from livestock. A woven-wire fence would be constructed around the repository to limit access.

The general construction steps for implementing Alternative 4b are as follows:

- improving access roads from the waste source areas to the repository;
- site clearing, preparation and debris removal;
- dewatering of the two ponds in the vicinity of tailings pile TP-1 to facility tailings removal and site reclamation;
- preparation of the repository base, including tree, stump and rock removal and recovery and stockpiling of cover soil;
- placement of the repository base GCL liner;
- excavation, loading, hauling, placement, grading and compaction of tailings from tailings piles TP-1 through TP-6;
- excavation, loading, hauling, placement, grading and compaction of impacted native soils from beneath tailings area;
- excavation, loading, hauling, placement, grading and compaction of waste rock from waste rock piles WR-1 through WR-4;
- installation of the cap GCL liner and geocomposite drainage layer;
- placement and grading of stockpiled cover soil on the repository;
- constructing surface water diversion ditches strategically located to control water runon in the vicinity of the repository;
- reconstruction of the Dog Creek stream channel in the vicinity of tailings piles TP-1 through TP-6.
- grading of native soil from the TP-1 and TP-2 dams onto the excavated source areas;
- establishing vegetation on the repository and excavated waste area by seeding and fertilizing;
- mulching of the seeded areas;
- constructing a 4-strand, barbed-wire fence around the perimeter of the excavated source areas; and
- construction of a woven-wire fence around the repository.

8.5 ALTERNATIVE 4c: ON-SITE DISPOSAL OF TAILINGS AND SELECTED WASTE ROCK IN A CONSTRUCTED UNLINED REPOSITORY WITH A MULTI-LAYERED CAP

The reclamation strategy for Alternative 4c involves removing the mill tailings sources from tailings piles TP-1, TP-2, TP-3, TP-4 (and the vat leach area), TP-5, TP-6; waste rock sources from piles WR-1, WR-2, WR-3 and WR-4; the Dog Creek floodplain tailings; and impacted native soil from beneath TP-1, TP-2, TP-4, TP-5, TP-6, and disposing these wastes in a constructed unlined repository with a multi-layered cap. The repository would consist of a composite, multi-layered, lined cap overlying the waste. Assuming that the tailings, selected waste rock and impacted soil volume was deposited in an area of approximately 4.39 acres, the total height of the repository would be approximately 54 feet, with a maximum waste thickness of approximately 36 feet, in order to achieve a 3:1 side slope design in the final cap.

WR3A and a portion of WR1A removed under Alternative 3 may also be placed in the repository (if Alternative 3 is implemented). The repository is designed to accommodate the waste from Alternative 3; however, the costs for removal and transportation of these wastes are included under Alternative 3.

The HELP model was used to simulate the unlined repository with a multi-layered cap scenario. Based on representative soil properties for the 1.5-foot cover soil, geocomposite drainage layer, geosynthetic clay liner, and an average of 14.5 feet of mine/mill waste, the predicted infiltration of water through the tailings is an average of 0.00054 inches per year over a 30-year period. This is equivalent to 0.003 percent of the average annual precipitation of 15.94 inches. An average of 14.498 inches of water per year is predicted to be lost through evapotranspiration, which is equivalent to 90.931 percent of the average annual precipitation of 15.94 inches. Surface water runoff accounts for a loss of 1.196 inches per year or 7.500 percent of precipitation. Lateral drainage from the geocomposite drainage layer accounts for a loss of 0.160 inches of water per year or 1.005 percent of precipitation. The remaining 0.561 percent of precipitation is accounted for by changes in water storage in the cover soil and tailings layers. The 0.00054 inches per year over the 4.39 acre repository area that is predicted to percolate from the bottom of the repository is equal to a discharge rate of 0.175 gallons per day over a 30 year period.

8.5.1 Overall Protection of Human Health and the Environment

This alternative provides control of direct exposure to the contaminated materials and reduction in risk to human health and the environment. It prevents further erosion and migration of contaminants from tailings source areas and waste rock from the Bald Butte Millsite area. Existing sediment in Dog Creek is not removed in this alternative, however, existing stream sediments should be diluted by mixing with natural sediment or through bedload dispersion downstream to achieve risk-based cleanup goals based on existing background levels.

Placing the wastes into a repository would prevent exposure by direct contact. Exposure to arsenic and lead via ingestion of water/fish is expected to be reduced to below risk-based cleanup goals since further erosion of contaminated sediments into Dog Creek would be prevented. Manganese exposure via the fish ingestion pathway would be reduced to levels consistent with background water quality, but would not achieve risk-based cleanup goals. Cleanup below background concentrations is not considered achievable. Carcinogenic risk from ingestion of arsenic via ingestion of water/fish would not be reduced to 1E-06.

Soil ingestion/dust inhalation of arsenic, lead and manganese would be reduced to below risk-based cleanup goals. Carcinogenic risk from soil ingestion/dust inhalation of arsenic would not be reduced to 1E-06.

Protection of the environment would generally be achieved under this alternative. Prevention of ecological exposures via exposure to water, sediment, and soil sources would be achieved to the extent practicable: deer exposure to lead via ingestion of tailings salts; plant phytotoxicity to arsenic, cadmium, copper, lead, manganese and zinc; acute exposure of aquatic life to arsenic, cadmium, copper, lead and zinc via surface water; and aquatic life exposure to cadmium and zinc via sediment would be reduced to risk-based cleanup levels. Since the waste sources would be removed from the vicinity of Dog Creek, arsenic, lead and zinc concentrations in the stream sediment would be reduced to levels consistent with background as existing sediments are either diluted by mixing with natural sediment or through bedload dispersion downstream, however, these concentrations may not be reduced below risk-based cleanup goals. A risk reduction achievement matrix for the various pathways and contaminants, identified in the baseline human health risk assessment and the ecological risk assessment, is shown in Table 8-12.

8.5.2 Compliance with ARARs

With the exception of lead and manganese, contaminant-specific ARARs are expected to be met when implementing this alternative. Table 8-13 shows that drinking water MCLs and/or HHS for arsenic, cadmium, copper, lead and zinc and ambient water quality criteria for arsenic and zinc are achieved in Dog Creek under this alternative. This is based on the assumption that elevated levels of these contaminants in surface water are attributed to the presence of contaminated sediments in Dog Creek and that sediments will eventually be sufficiently diluted such that they do not cause significant metals loading to Dog Creek. Implementation of this alternative will prevent further erosion of tailings into Dog Creek. Drinking water MCLs and/or HHS for manganese and ambient water quality criteria for lead are not achieved under this alternative. Background water quality exceeds MCLs and/or HHS for manganese and exceeds CALS for lead. However, cleanup below background concentrations is not considered achievable. Ambient water quality standards for cadmium and copper may be achieved; however, this is unknown because the laboratory detection limit for these elements was greater than the water quality standard.

Implementation of this alternative is also expected to satisfy air quality regulations because the repository cap and vegetation cover would stabilize the contaminant sources and inhibit fugitive emissions. The tailings have the highest potential for fugitive emissions based on grain size.

Location-specific ARARs are expected to be met in the implementation of this alternative. Contacts with the appropriate agencies and acquisition of required permits related to streambeds, floodplains, and archaeological/paleontological resources would be completed.

Action-specific ARARs are expected to be met including the hydrological regulations contained in the Strip and Underground Mine Reclamation Act. The tailings and waste rock materials of concern are derived from the beneficiation and extraction of ores and are therefore exempt from federal regulation under the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. 6921 (b) (3) (A)(iii)(1994) as a hazardous waste. Mine and mill wastes are also excluded under the Montana Solid Waste Management Act (75-10-214 (1)(b) MCA. Any temporary stream

Table 8-12. Risk Reduction Achievement Matrix for Alternative 4c

Exposure Pathway	Risk Level	Arsenic Cleanup Goal	Arsenic Achieve Goal	Cadmium Cleanup Goal	Cadmium Achieve Goal	Copper Cleanup Goal	Copper Achieve Goal	Lead Cleanup Goal	Lead Achieve Goal	Manganese Cleanup Goal	Manganese Achieve Goal	Zinc Cleanup Goal	Zinc Achieve Goal
Human Risk:													
Water Ingestion/Fish Ingestion Pathway (ug/l)	HQ=1	36.7	Yes					165	Yes	33.7	No		
	Carc. 1E-06	0.158	No										
	Carc. 1E-05	1.58	No										
	Carc. 1E-04	15.8	Yes										
Soil Ingestion/Dust Inhalation Pathway (mg/Kg)	HQ=1	323	Yes					2200	Yes	1330	Yes		
	Carc. 1E-06	1.39	No										
	Carc. 1E-05	13.9	No										
	Carc. 1E-04	139	Yes										
Ecological Risk Scenario:	EQ=1												
Deer - Tailings Salt Ingestion (mg/Kg)	LOAEL	NA		NA		NA		314	Yes	NA		NA	
Plant Phytotoxicity - Soil (mg/Kg)	Max Phytotox.	50	Yes	8	Yes	125	Yes	400	Yes	3000	Yes	400	Yes
Aquatic Life - Water (ug/l)	AALS	340	Yes	2.1	Yes	14	Yes	81.6	Yes	NA		120	Yes
Aquatic Life - Sediment (mg/Kg)	PSQC	85	No	9	Yes	390	Yes	110	No	NA		270	No

Notes: NA - Not Applicable

LOAEL - Lower observed adverse effect level

AALS - Freshwater Acute Aquatic Life Standards (DEQ, 2002). Hardness = 100 mg/l $CaCO_3$ for hardness dependent elements.

PSQC - Proposed Sediment Quality Criteria

Table 8-13. Water Quality ARARs Attainment for Alternative 4c

	Arsenic Cleanup Goal	Arsenic Achieve Goal	Cadmium Cleanup Goal	Cadmium Achieve Goal	Copper Cleanup Goal	Copper Achieve Goal	Lead Cleanup Goal	Lead Achieve Goal	Manganese Cleanup Goal	Manganese Achieve Goal	Zinc Cleanup Goal	Zinc Achieve Goal
Drinking Water MCL/HHS	18	Yes	5	Yes	1300	Yes	15	Yes	50	No	2000	Yes
Aquatic Life CALS	150	Yes	0.27	Unk	9.3	Unk	3.2	No	NA		119.8	Yes

HHS - Human Health Standards for Surface Water (DEQ, 2002)

MCL - Maximum Contaminant Level Drinking Water Regulations and Health Advisories, (EPA, 1993)

CALS - Freshwater Chronic Aquatic Life Standards (DEQ, 2002)

Water concentrations in ug/L.

CALS based on water hardness of 100 mg/L.

Unk - Unknown. Cleanup goal is less than the detection limit.

diversions for construction activities will require coordination with the Montana Department of Fish, Wildlife, and Parks, The U.S. Army Corps of Engineers, the Montana Department of Natural Resources and Conservation, and the Lewis & Clark County Conservation District. Revegetation requirements contained in the Surface Mining and Control Reclamation Act would be met. State of Montana air quality regulations related to dust suppression and control during construction activities will be met using water sprays where applicable, i.e. excavation areas in the tailings and waste rock, and haul roads with heavy vehicular traffic.

Occupational Safety and Health Administration (OSHA) requirements would be met by requiring appropriate safety training for all on-site workers during the construction phase. Site activities would be conducted under the guidance of a Health and Safety Plan for the site as per OSHA 29 CFR 1910.120. Site personnel will have completed 40-hour hazardous waste operations and emergency response training and would be current on the 8-hour annual refresher training as required by OSHA.

8.5.3 Long-Term Effectiveness and Permanence

This alternative would reduce contaminant mobility at the site by removing the highest risk, solid media contaminant sources and disposing of these wastes in an engineered repository. The tailings, waste rock and impacted soil would be encapsulated in an engineered repository that would effectively isolate this waste and reduce contaminant mobility. Periodic inspections and maintenance would ensure the long-term stability of the repository.

8.5.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Reduction of contaminant mobility is the primary objective of this alternative. The volume or toxicity of the contaminants in the tailings and waste rock would not be physically nor chemically reduced. The excavation of the tailings from the drainage area would reduce the contaminant mobility by moving the waste to a secure location. The primary waste sources of concern (tailings and waste rock piles) would be encapsulated in an engineered structure and physical location which is protected from erosion and water infiltration problems.

8.5.5 Short-Term Effectiveness

It is anticipated that construction activities related to the implementation of this alternative would be completed in one construction season. Impacts associated with construction activities would generally be less than 120 days and should not significantly impact human health nor the environment. On-site workers would be protected by following a site specific Health and Safety Plan, employing appropriate personal protective equipment and by following proper operating and safety procedures. However, short term air quality impacts to the immediate environment may occur due to the relatively large volume of waste excavation and hauling. Control of fugitive dust may require the use of water sprays. Short-term impacts to the surrounding community are expected to be minimal due to the location of the project site. The only foreseen short-term impact to the surrounding community would involve increased vehicle traffic, with associated safety hazards and dust generation, on roads in the vicinity of the waste sources and the repository.

8.5.6 Implementability

This alternative is both technically and administratively feasible. Waste removal, repository construction, and establishing vegetation are readily implementable using conventional construction techniques. Key project components, such as the availability of equipment, materials, and construction expertise, are present and would aid in the timely implementation and successful execution of the proposed project.

8.5.7 Costs

The total present-worth cost for this alternative has been estimated at $2,639,973 which represents the removal of the tailings, selected waste rock and impacted soil to a constructed unlined repository with a multi-layered cap. Table 8-14 presents the cost details associated with implementing this alternative. The total cost includes the present-worth value of 30 years of annual maintenance and monitoring costs in addition to capital costs.

Conceptual Design and Assumptions

The repository area was selected largely because it is one of the only areas in the vicinity of the project that is relatively open and flat. The base of the repository would be constructed on a bench above Dog Creek, and keyed into the hillside to the east. This area comprises roughly 5 acres that appear to be appropriate for the construction of a repository. The proposed repository site is located on a narrow bench above Dog Creek, and would be constructed against the existing hillside on the east side of Dog Creek. The repository area has been logged in the past and has abundant tree stumps that would require removal prior to waste placement.

A considerable amount of heavy equipment/machinery would be necessary to efficiently implement these alternatives. To construct the repository and load out the waste material, as well as construct runon/runoff control structures, equipment requirements would include, but not be limited to, multiple bulldozers, front end loaders and excavators. Haul trucks or scrapers would also be required to transport and deposit the contaminated material in the constructed repository. The field procedure would involve improving the existing roads from the tailings and waste rock pile areas to the repository area to a one lane haul road with turnouts to allow unobstructed access for heavy equipment. The number of loaders, haul trucks and/or scrapers would be maximized to the extent possible to reduce the overall time required to complete the project's construction phase.

Removal of the Bald Butte millsite tailings piles would require the construction of temporary diversions of Dog Creek around tailings piles TP-1, TP-2 and TP-3; tailings pile TP-5; and tailings pile TP-6 to facilitate the removal of tailings. After the repository construction, waste excavation, and waste placement are complete, the excavated areas would be revegetated. Cover/fill soil may be required in the excavated areas to level and contour the areas to match the surrounding terrain. It is assumed that soil from the repository excavation would be stockpiled and used for cover soil on the repository. Native soil from the TP-1 and TP-2 dams would be graded onto the excavation source areas prior to revegetation. It is possible that a pond could be reconstructed in the area of the existing Pond 2 (Figure 3-2) to continue the current level of recreational opportunities. If a pond is reconstructed, the native soil from the TP-1 and TP-2 dams would be used to construct the pond dam.

Table 8-14. Preliminary Cost Estimate for Alternative 4c: On-Site Disposal of Tailings and Selected Waste Rock in a Constructed Unlined Repository with a Multi-Layered Cap

Task	Quantity	Units	Unit $	Cost $	Comment
Mobilization, Bonding & Insurance	1	L.S.	153,039	$153,039	8%
Logistics					
Access Road Improvements	15,500	LF	1.00	$15,500	
Site Clearing/Preparation	24.92	Ac	2,000	$49,840	
Dog Creek Stream Diversions	6,700	LF	25.00	$167,500	
Dewater Ponds	1	LS	10,000	$10,000	
Debris Removal and Onsite Disposal	1	LS	10,000	$10,000	
Repository Construction					
Cover Soil Removal and Stockpiling	10,840	CY	2.00	$21,680	
Repository Base Grading	4.39	Ac	2,000	$8,789	
Waste Load, Haul & Dump					
Tailings	70,650	CY	4.00	$282,600	
Dog Creek Floodplain Tailings	7,510	CY	6.00	$45,060	
Impacted Soil	33,830	CY	4.00	$135,320	
Bald Butte Waste Rock	2,874	CY	4.00	$11,496	
Waste Grading and Compaction	114,864	CY	2.00	$229,728	
Repository Cap Construction					
Install Geotextile Cushion	21,680	SY	3.00	$65,040	
Geosynthetic Clay Liner	21,680	SY	4.50	$97,560	
Geocomposite Drainage Layer	21,680	SY	4.50	$97,560	
Cover Soil	10,840	CY	2.00	$21,680	
Stream Channel Reconstruction	6,500	LF	80.00	$520,000	
Water Diversion/Runon Controls					
Run-on Control Ditch	1,000	LF	2.00	$2,000	
Grade Native Soil Dams	7,200	CY	2.00	$14,400	
Revegetation					
Seed/Fertilize	24.92	Ac	1,000	$24,920	
Mulch	24.92	Ac	1,000	$24,920	
Fencing					
Barbed-wire Fence	17,200	LF	2.50	$43,000	
Repository Fence	2,400	LF	6.00	$14,400	
Subtotal				$2,066,032	
Construction Oversight	15%			$309,905	
Subtotal Capital Costs				$2,375,937	
Contingency	10%			$237,594	
TOTAL CAPITAL COSTS				$2,613,531	
POST CLOSURE MONITORING AND MAINTENANCE COSTS					
Inspections	1	/Year	250	$250	
Sampling & Analysis	4	/Year	200	$800	
Maintenance	1	L.S.	1500	$1,500	
Subtotal				$2,550	
Contingency	10%			$255	
TOTAL ANNUAL O&M COST				$2,805	
TOTAL CAPITAL COSTS				$2,613,531	
PRESENT WORTH O&M COST	30	yrs @	10%	$26,442	
TOTAL PRESENT WORTH COST				$2,639,973	

The seed beds would be prepared using conventional agricultural plowing. Seeding would likely take place during the fall of the year. The seed mixture and fertilizer would be applied simultaneously to the prepared seed beds via drill application. Mulch would be applied to promote temporary protection of exposed erodible surfaces. Wheat or barley straw mulch (certified weed-free) would be applied over the excavated areas and the repository cap with a tow spreader or pneumatic spreader utilizing tucking/crimping as the anchoring mechanism. A runon/runoff control ditch would be constructed in the area of the repository to divert runoff away from the repository cap. Barbed-wire fencing would be placed around the excavated waste source areas to allow the establishment of vegetation without interference from livestock. A woven-wire fence would be constructed around the repository to limit access.

The general construction steps for implementing Alternative 4c are as follows:

- improving access roads from the waste source areas to the repository;
- site clearing, preparation and debris removal;
- dewatering of the two ponds in the vicinity of tailings pile TP-1 to facility tailings removal and site reclamation;
- preparation of the repository base, including tree, stump and rock removal and recovery and stockpiling of cover soil;
- excavation, loading, hauling, placement, grading and compaction of tailings from tailings piles TP-1 through TP-6;
- excavation, loading, hauling, placement, grading and compaction of impacted native soils from beneath tailings area;
- excavation, loading, hauling, placement, grading and compaction of waste rock from waste rock piles WR-1 through WR-4;
- installation of the cap liners and geocomposite drainage layer;
- placement and grading of stockpiled cover soil on the repository;
- constructing surface water diversion ditches strategically located to control water runon in the vicinity of the repository;
- reconstruction of the Dog Creek stream channel in the vicinity of tailings piles TP-1 through TP-6.
- grading of native soil from the TP-1 and TP-2 dams onto the excavated source areas;
- establishing vegetation on the repository and excavated waste area by seeding and fertilizing;
- mulching of the seeded areas;
- constructing a 4-strand, barbed-wire fence around the perimeter of the excavated source areas; and

- construction of a woven-wire fence around the repository.

8.6 ALTERNATIVE 7a: ON-SITE DISPOSAL OF TAILINGS AND WASTE ROCK IN A CONSTRUCTED RCRA REPOSITORY

The reclamation strategy for Alternative 7a involves removing all mill tailings and waste rock sources and disposing these wastes in a constructed repository which complies with RCRA Subtitle C regulations for hazardous waste landfill closures (Figure 7-1). The only exception to the RCRA Subtitle C regulations would be the use of a GCL in place of a compacted clay liner. This is based on the site characterization results, which did not reveal the presence of a clay borrow source in the vicinity of the site. The repository would consist of a composite, double-lined leachate collection and removal system underlying the waste in conjunction with a composite, multi-layered, lined cap overlying the waste. Assuming that the tailings, waste rock and impacted soil volume was deposited in an area of approximately 4.92 acres, the total height of the repository would be approximately 64 feet, with a maximum waste thickness of approximately 46 feet, in order to achieve a 3:1 side slope design in the final cap.

The flowing adit at waste rock pile WR1A (sample GW1) exceeds Federal MCLs and Montana HHS for Cd (18 ug/L) and Mn (310 ug/L), and Montana HHS for Zn (3,550 ug/l). In addition, Cd, Cu and Zn exceed acute and chronic ALS and Pb exceeds chronic ALS in the mine adit discharge water. The underground workings are the most likely source of metals in the adit discharge. Sealing the adits to stop the discharge is not considered a reliable control measure because the flow will likely build up in the extensive underground workings and emerge uncontrolled from another location. Based on the above discussion, there is no effective means to control the discharge without the use of high-cost, high-maintenance treatment systems. Long-term treatment of the adit discharge water is considered cost prohibitive and infeasible.

Under Alternative 7a, the adit discharge water would be collected near the adit opening and conveyed to an infiltration gallery in the valley floor where it will infiltrate into the alluvium. The purpose of the infiltration gallery is to eliminate the potential ingestion of the adit discharge water.

The HELP model was used to simulate the RCRA Subtitle C repository scenario. Based on representative soil properties for the 1.5-foot cover soil, gravel drainage layer, 20-mil flexible membrane liner, geosynthetic clay liner (substituted for the compacted clay liner), an average of 17.9 feet of mine/mill waste, a gravel primary leachate collection/removal layer, 30-mil flexible membrane liner, a gravel secondary leachate collection/removal layer, a 30-mil flexible membrane liner and a geosynthetic clay liner (substituted for the compacted clay liner), the predicted infiltration of water through the repository base liner system is an average of 0.00000 inches per year over a 30-year period. An average of 14.499 inches of water per year is predicted to be lost through evapotranspiration, which is equivalent to 90.938 percent of the average annual precipitation of 15.94 inches. Surface water runoff accounts for a loss of 1.196 inches per year or 7.500 percent of precipitation. Lateral drainage from the geocomposite drainage layer accounts for a loss of 0.160 inches of water per year or 1.001 percent of precipitation. The remaining 0.561 percent of precipitation is accounted for by changes in water storage in the cover soil and tailings layers.

8.6.1 Overall Protection of Human Health and the Environment

This alternative provides control of direct exposure to the contaminated materials and reduction in risk to human health and the environment. It prevents further erosion and migration of contaminants from tailings and waste rock source areas. Existing sediment in Dog Creek is not removed in this alternative, however, existing stream sediments should be diluted by mixing with natural sediment or through bedload dispersion downstream to achieve risk-based cleanup goals based on existing background levels.

Placing the wastes into a repository would prevent exposure by direct contact. Exposure to arsenic and lead via ingestion of water/fish is expected to be reduced to below risk-based cleanup goals since further erosion of contaminated sediments into Dog Creek would be prevented. Manganese exposure via the fish ingestion pathway would be reduced to levels consistent with background water quality, but would not achieve risk-based cleanup goals. Cleanup below background concentrations is not considered achievable. Carcinogenic risk from ingestion of arsenic via ingestion of water/fish would not be reduced to 1E-06. Routing of the adit discharge water to an infiltration gallery would eliminate ingestion of the water, which exceeds both human health and aquatic life standards.

Soil ingestion/dust inhalation of arsenic, lead and manganese would be reduced to below risk-based cleanup goals. Carcinogenic risk from soil ingestion/dust inhalation of arsenic would not be reduced to 1E-06.

Protection of the environment would generally be achieved under this alternative. Prevention of ecological exposures via exposure to water, sediment, and soil sources would be achieved to the extent practicable: deer exposure to lead via ingestion of tailings salts; plant phytotoxicity to arsenic, cadmium, copper, lead, manganese and zinc; acute exposure of aquatic life to arsenic, cadmium, copper, lead and zinc via surface water; and aquatic life exposure to cadmium and zinc via sediment would be reduced to risk-based cleanup levels. Since the waste sources would be removed from the vicinity of Dog Creek, arsenic, lead and zinc concentrations in the stream sediment would be reduced to levels consistent with background as existing sediments are either diluted by mixing with natural sediment or through bedload dispersion downstream, however, these concentrations may not be reduced below risk-based cleanup goals. A risk reduction achievement matrix for the various pathways and contaminants, identified in the baseline human health risk assessment and the ecological risk assessment, is shown in Table 8-15.

8.6.2 Compliance with ARARs

With the exception of lead and manganese, contaminant-specific ARARs are expected to be met when implementing this alternative. Table 8-16 shows that drinking water MCLs and/or HHS for arsenic, cadmium, copper, lead and zinc and ambient water quality criteria for arsenic and zinc are achieved in Dog Creek under this alternative. This is based on the assumption that elevated levels of these contaminants in surface water are attributed to the presence of contaminated sediments in Dog Creek and that sediments will eventually be sufficiently diluted such that they do not cause significant metals loading to Dog Creek. Implementation of this alternative will prevent further erosion of tailings into Dog Creek. Drinking water MCLs and/or HHS for manganese and ambient water quality criteria for lead are not achieved under this alternative. Background water quality exceeds MCLs and/or HHS for manganese and exceeds

Table 8-15. Risk Reduction Achievement Matrix for Alternative 7a

Exposure Pathway	Risk Level	Arsenic		Cadmium		Copper		Lead		Manganese		Zinc	
		Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal
Human Risk:													
Water Ingestion/Fish Ingestion Pathway (ug/l)	HQ=1	36.7	Yes					165	Yes	33.7	No		
	Carc. 1E-06	0.158	No										
	Carc. 1E-05	1.58	No										
	Carc. 1E-04	15.8	Yes										
Soil Ingestion/Dust Inhalation Pathway (mg/Kg)	HQ=1	323	Yes					2200	Yes	1330	Yes		
	Carc. 1E-06	1.39	No										
	Carc. 1E-05	13.9	No										
	Carc. 1E-04	139	Yes										
Ecological Risk Scenario:	EQ=1												
Deer - Tailings Salt Ingestion (mg/Kg)	LOAEL	NA		NA		NA		314	Yes	NA		NA	
Plant Phytotoxicity - Soil (mg/Kg)	Max Phytotox.	50	Yes	8	Yes	125	Yes	400	Yes	3000	Yes	400	Yes
Aquatic Life - Water (ug/l)	AALS	340	Yes	2.1	Yes	14	Yes	81.6	Yes	NA		120	Yes
Aquatic Life - Sediment (mg/Kg)	PSQC	85	No	9	Yes	390	Yes	110	No	NA		270	No

Notes: NA - Not Applicable

LOAEL - Lower observed adverse effect level

AALS - Freshwater Acute Aquatic Life Standards (DEQ, 2002). Hardness = 100 mg/l $CaCO_3$ for hardness dependent elements.

PSQC - Proposed Sediment Quality Criteria

Table 8-16. Water Quality ARARs Attainment for Alternative 7a

	Arsenic		Cadmium		Copper		Lead		Manganese		Zinc	
	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal
Drinking Water MCL/HHS	18	Yes	5	Yes	1300	Yes	15	Yes	50	No	2000	Yes
Aquatic Life CALS	150	Yes	0.27	Unk	9.3	Unk	3.2	No	NA		119.8	Yes

HHS - Human Health Standards for Surface Water (DEQ, 2002)

MCL - Maximum Contaminant Level Drinking Water Regulations and Health Advisories, (EPA, 1993)

CALS - Freshwater Chronic Aquatic Life Standards (DEQ, 2002)

Water concentrations in ug/L.

CALS based on water hardness of 100 mg/L.

Unk - Unknown. Cleanup goal is less than the detection limit.

CALS for lead. However, cleanup below background concentrations is not considered achievable. Ambient water quality standards for cadmium and copper may be achieved; however, this is unknown because the laboratory detection limit for these elements was greater than the water quality standard.

Cadmium, manganese and zinc exceed Federal MCLs or Montana HHS criteria and cadmium, copper and zinc exceed acute and chronic and lead exceeds chronic aquatic life standards in the discharge from the adit at waste rock pile WR1A. Under this alternative, it is proposed that the adit discharge be collected and discharged to a subsurface infiltration gallery. The adit discharge currently flows into the unnamed tributary to Dog Creek and flows over waste rock pile WR1A. Subsurface disposal of the adit discharge will effectively eliminate the direct exposure pathway under a recreational risk scenario (i.e., hikers, etc. drinking directly from the adit). However, this scenario is not necessarily protective of ground water resources. Ground water was not characterized during the site characterization.

Implementation of this alternative is also expected to satisfy air quality regulations because the repository cap and vegetation cover would stabilize the contaminant sources and inhibit fugitive emissions. The tailings have the highest potential for fugitive emissions based on grain size.

Location-specific ARARs are expected to be met in the implementation of this alternative. Contacts with the appropriate agencies and acquisition of required permits related to streambeds, floodplains, and archaeological/paleontological resources would be completed.

Action-specific ARARs are expected to be met including the hydrological regulations contained in the Strip and Underground Mine Reclamation Act. The tailings and waste rock materials of concern are derived from the beneficiation and extraction of ores and are therefore exempt from federal regulation under the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. 6921 (b) (3) (A)(iii)(1994) as a hazardous waste. Mine and mill wastes are also excluded under the Montana Solid Waste Management Act (75-10-214 (1)(b) MCA. Any temporary stream diversions for construction activities will require coordination with the Montana Department of Fish, Wildlife, and Parks, The U.S. Army Corps of Engineers, the Montana Department of Natural Resources and Conservation, and the Lewis & Clark County Conservation District. Revegetation requirements contained in the Surface Mining and Control Reclamation Act would be met. State of Montana air quality regulations related to dust suppression and control during construction activities will be met using water sprays where applicable, i.e. excavation areas in the tailings and waste rock and haul roads with heavy vehicular traffic.

Occupational Safety and Health Administration (OSHA) requirements would be met by requiring appropriate safety training for all on-site workers during the construction phase. Site activities would be conducted under the guidance of a Health and Safety Plan for the site as per OSHA 29 CFR 1910.120. Site personnel will have completed 40-hour hazardous waste operations and emergency response training and would be current on the 8-hour annual refresher training as required by OSHA.

8.6.3 Long-Term Effectiveness and Permanence

This alternative would reduce contaminant mobility at the site by removing the highest risk, solid media contaminant sources and disposing of these wastes in an engineered repository. The tailings, waste rock and impacted soil would be encapsulated in an engineered repository that would effectively isolate this waste and reduce contaminant mobility. Periodic inspections and maintenance would ensure the long-term stability of the repository.

8.6.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Reduction of contaminant mobility is the primary objective of this alternative. The volume or toxicity of the contaminants in the tailings and waste rock would not be physically nor chemically reduced. The excavation of the tailings and waste rock from the drainage area would reduce the contaminant mobility by moving the waste to a secure location. The primary waste sources of concern (tailings and waste rock piles) would be encapsulated in an engineered structure and physical location which is protected from erosion and water infiltration problems.

8.6.5 Short-Term Effectiveness

It is anticipated that construction activities related to the implementation of this alternative would be completed in one construction season. Impacts associated with construction activities would generally be less than 120 days and should not significantly impact human health nor the environment. On-site workers would be protected by following a site specific Health and Safety Plan, employing appropriate personal protective equipment and by following proper operating and safety procedures. However, short term air quality impacts to the immediate environment may occur due to the relatively large volume of waste excavation and hauling. Control of fugitive dust may require the use of water sprays. Short-term impacts to the surrounding community are expected to be minimal due to the location of the project site. The only foreseen short-term impact to the surrounding community would involve increased vehicle traffic, with associated safety hazards and dust generation, on roads in the vicinity of the waste sources and the repository.

8.6.6 Implementability

This alternative is both technically and administratively feasible. Waste removal, repository construction, and establishing vegetation are readily implementable using conventional construction techniques. Key project components, such as the availability of equipment, materials, and construction expertise, are present and would aid in the timely implementation and successful execution of the proposed project.

8.6.7 Costs

The total present-worth cost for this alternative has been estimated at $4,562,890 which represents the removal of the tailings, waste rock and impacted soil to a constructed RCRA-lined repository with leachate collection system. Table 8-17 presents the cost details associated with implementing this alternative. The total cost includes the present-worth value of 30 years of annual maintenance and monitoring costs in addition to capital costs.

Table 8-17. Preliminary Cost Estimate for Alternative 7a: On-Site Disposal of Tailings and Waste Rock in a Constructed RCRA Repository

Task	Quantity	Units	Unit $	Cost $	Comment
Mobilization, Bonding & Insurance	1	L.S.	265,639	$265,639	8%
Logistics					
Access Road Improvements	15,500	LF	1.00	$15,500	
Site Clearing/Preparation	27.83	Ac	2,000	$55,660	
Dog Creek Stream Diversions	6,700	LF	25.00	$167,500	
Unnamed Tributary Stream Diversion	600	LF	25.00	$15,000	
Dewater Ponds	1	LS	10,000	$10,000	
Debris Removal and Onsite Disposal	1	LS	15,000	$15,000	
Repository Construction					
Cover Soil Removal and Stockpiling	12,130	CY	2.00	$24,260	
Repository Base Grading	4.92	Ac	2,000	$9,831	
Install Geotextile Cushion	23,800	SY	3.00	$71,400	
Geosynthetic Clay Liner	23,800	SY	4.50	$107,100	
Install 30 mil Flexible Membrane Liner	23,800	SY	6.00	$142,800	
Gravel Drainage Layer	7,940	CY	20.00	$158,800	
Install 30 mil Flexible Membrane Liner	23,800	SY	6.00	$142,800	
Gravel Drainage Layer	7,940	CY	20.00	$158,800	
Geotextile Filter Fabric	23,800	SY	3.00	$71,400	
Leachate Collection System	1	LS	10,000	$10,000	
Waste Load, Haul & Dump					
Tailings	70,650	CY	4.00	$282,600	
Dog Creek Floodplain Tailings	7,510	CY	6.00	$45,060	
Impacted Soil	33,830	CY	4.00	$135,320	
Bald Butte Waste Rock	2,874	CY	4.00	$11,496	
Devon/Sterling and Albion Waste Rock	32,940	CY	7.00	$230,580	
Waste Grading and Compaction	147,804	CY	2.00	$295,608	
Repository Cap Construction					
Install Geotextile Cushion	24,250	SY	3.00	$72,750	
Geosynthetic Clay Liner	24,250	SY	4.50	$109,125	
Install 20 mil Flexible Membrane Liner	24,250	SY	5.00	$121,250	
Geocomposite Drainage Layer	24,250	SY	4.50	$109,125	
Cover Soil	12,130	CY	2.00	$24,260	
Stream Channel Reconstruction	7,100	LF	80.00	$568,000	
Water Diversion/Runon Controls					
Run-on Control Ditch	1,000	LF	2.00	$2,000	
Adit Discharge Infiltration Gallery	1	LS	10,000	$10,000	
Grade Native Soil Dams	7,200	CY	2	$14,400	
Revegetation					
Seed/Fertilize	27.83	Ac	1,000	$27,830	
Mulch	27.83	Ac	1,000	$27,830	
Fencing					
Barbed-wire Fence	17,200	LF	2.50	$43,000	
Repository Fence	2,400	LF	6.00	$14,400	
Subtotal				$3,586,124	
Construction Oversight	15%			$537,919	
Subtotal Capital Costs				$4,124,043	
Contingency	10%			$412,404	
TOTAL CAPITAL COSTS				$4,536,447	
POST CLOSURE MONITORING AND MAINTENANCE COSTS					
Inspections	1	/Year	250	$250	
Sampling & Analysis	4	/Year	200	$800	
Maintenance	1	L.S.	1500	$1,500	
Subtotal				$2,550	
Contingency	10%			$255	
TOTAL ANNUAL O&M COST				$2,805	
TOTAL CAPITAL COSTS				$4,536,447	
PRESENT WORTH O&M COST	30	yrs @	10%	$26,442	
TOTAL PRESENT WORTH COST				$4,562,890	

Conceptual Design and Assumptions

The repository area was selected largely because it is one of the only areas in the vicinity of the project that is relatively open and flat. The base of the repository would be constructed on a bench above Dog Creek, and keyed into the hillside to the east. This area comprises roughly 5 acres that appear to be appropriate for the construction of a repository. The proposed repository site is located on a narrow bench above Dog Creek, and would be constructed against the existing hillside on the east side of Dog Creek. The repository area has been logged in the past and has abundant tree stumps that would require removal prior to installation of the base liners and leachate collection system.

A considerable amount of heavy equipment/machinery would be necessary to efficiently implement these alternatives. To construct the repository and load out the waste material, as well as construct runon/runoff control structures, equipment requirements would include, but not be limited to, multiple bulldozers, front end loaders and excavators. Haul trucks or scrapers would also be required to transport and deposit the contaminated material in the constructed repository. The field procedure would involve improving the existing roads from the tailings and waste rock pile areas to the repository area to a one lane haul road with turnouts to allow unobstructed access for heavy equipment. The number of loaders, haul trucks and/or scrapers would be maximized to the extent possible to reduce the overall time required to complete the project's construction phase.

Removal of the Bald Butte millsite tailings piles would require the construction of temporary diversions of Dog Creek around tailings piles TP-1, TP-2 and TP-3; tailings pile TP-5; and tailings pile TP-6 to facilitate the removal of tailings. After the repository construction, waste excavation, and waste placement are complete, the excavated areas would be revegetated. Cover/fill soil may be required in the excavated areas to level and contour the areas to match the surrounding terrain. It is assumed that soil from the repository excavation would be stockpiled and used for cover soil on the repository. Native soil from the TP-1 and TP-2 dams would be graded onto the excavation source areas prior to revegetation. It is possible that a pond could be reconstructed in the area of the existing Pond 2 (Figure 3-2) to continue the current level of recreational opportunities. If a pond is reconstructed, the native soil from the TP-1 and TP-2 dams would be used to construct the pond dam.

The seed beds would be prepared using conventional agricultural plowing. Seeding would likely take place during the fall of the year. The seed mixture and fertilizer would be applied simultaneously to the prepared seed beds via drill application. Mulch would be applied to promote temporary protection of exposed erodible surfaces. Wheat or barley straw mulch (certified weed-free) would be applied over the excavated areas and the repository cap with a tow spreader or pneumatic spreader utilizing tucking/crimping as the anchoring mechanism. A runon/runoff control ditch would be constructed in the area of the repository to divert runoff away from the repository cap. Barbed-wire fencing would be placed around the excavated waste source areas to allow the establishment of vegetation without interference from livestock. A woven-wire fence would be constructed around the repository to limit access.

The general construction steps for implementing Alternative 7a are as follows:

- improving access roads from the waste source areas to the repository;
- site clearing, preparation and debris removal;

- dewatering of the two ponds in the vicinity of tailings pile TP-1 to facility tailings removal and site reclamation;

- preparation of the repository base, including tree, stump and rock removal and recovery and stockpiling of cover soil;

- placement of the repository base liner and leachate collection system;

- excavation, loading, hauling, placement, grading and compaction of tailings from tailings piles TP-1 through TP-6;

- excavation, loading, hauling, placement, grading and compaction of impacted native soils from beneath tailings area;

- excavation, loading, hauling, placement, grading and compaction of waste rock from waste rock piles WR-1 through WR-4 and WR1A through WR3A;

- installation of the cap liners and geocomposite drainage layer;

- placement and grading of stockpiled cover soil on the repository;

- constructing surface water diversion ditches strategically located to control water runon in the vicinity of the repository;

- reconstruction of the Dog Creek stream channel in the vicinity of tailings piles TP-1 through TP-6;

- grading of native soil from the TP-1 and TP-2 dams onto the excavated source areas;

- reconstruction of the unnamed tributary of Dog Creek through a portion waste rock pile WR1A;

- diversion of adit discharge water to a subsurface infiltration gallery to eliminate exposure by direct contact;

- establishing vegetation on the repository and excavated waste area by seeding and fertilizing;

- mulching of the seeded areas;

- constructing a 4-strand, barbed-wire fence around the perimeter of the excavated source areas; and

- construction of a woven-wire fence around the repository.

8.7 ALTERNATIVE 7b: ON-SITE DISPOSAL OF TAILINGS AND WASTE ROCK IN A CONSTRUCTED MODIFIED RCRA REPOSITORY

The reclamation strategy for Alternative 7b involves removing all mill tailings and waste rock sources and disposing these wastes in a constructed modified RCRA repository which includes a single GCL base liner (without a leachate collection and removal system) and a multi-layered cap. The repository would consist of a geosynthetic clay liner underlying the waste in conjunction with a composite, multi-layered, lined cap overlying the waste. Assuming that the mine/mill waste volume was deposited in an area of approximately 4.92 acres, the total height of the repository would be approximately 64 feet, with a maximum waste thickness of approximately 46 feet, in order to achieve a 3:1 side slope design in the final cap.

The flowing adit at waste rock pile WR1A (sample GW1) exceeds Federal MCLs and Montana HHS for Cd (18 ug/L) and Mn (310 ug/L), and Montana HHS for Zn (3,550 ug/l). In addition, Cd, Cu and Zn exceed acute and chronic ALS and Pb exceeds chronic ALS in the mine adit discharge water. The underground workings are the most likely source of metals in the adit discharge. Sealing the adits to stop the discharge is not considered a reliable control measure because the flow will likely build up in the extensive underground workings and emerge uncontrolled from another location. Based on the above discussion, there is no effective means to control the discharge without the use of high-cost, high-maintenance treatment systems. Long-term treatment of the adit discharge water is considered cost prohibitive and infeasible.

Under Alternative 7b, the adit discharge water would be collected near the adit opening and conveyed to an infiltration gallery in the valley floor where it will infiltrate into the alluvium. The purpose of the infiltration gallery is to eliminate the potential ingestion of the adit discharge water.

The HELP model was used to simulate the modified RCRA repository scenario. Based on representative soil properties for the 1.5-foot cover soil, geocomposite drainage layer, geosynthetic clay liner, an average of 17.9 feet of mine/mill waste, a base flexible membrane liner, and a base geosynthetic clay liner, the predicted infiltration of water through the repository base liner system is an average of 0.00000 inches per year over a 30-year period. An average of 14.498 inches of water per year is predicted to be lost through evapotranspiration, which is equivalent to 90.931 percent of the average annual precipitation of 15.94 inches. Surface water runoff accounts for a loss of 1.196 inches per year or 7.500 percent of precipitation. Lateral drainage from the geocomposite drainage layer accounts for a loss of 0.160 inches of water per year or 1.001 percent of precipitation. The remaining 0.561 percent of precipitation is accounted for by changes in water storage in the cover soil and tailings layers.

8.7.1 Overall Protection of Human Health and the Environment

This alternative provides control of direct exposure to the contaminated materials and reduction in risk to human health and the environment. It prevents further erosion and migration of contaminants from tailings and waste rock source areas. Existing sediment in Dog Creek is not removed in this alternative, however, existing stream sediments should be diluted by mixing with natural sediment or through bedload dispersion downstream to achieve risk-based cleanup goals based on existing background levels.

Placing the wastes into a repository would prevent exposure by direct contact. Exposure to arsenic and lead via ingestion of water/fish is expected to be reduced to below risk-based cleanup goals since further erosion of contaminated sediments into Dog Creek would be prevented. Manganese exposure via the fish ingestion pathway would be reduced to levels consistent with background water quality, but would not achieve risk-based cleanup goals. Cleanup below background concentrations is not considered achievable. Carcinogenic risk from ingestion of arsenic via ingestion of water/fish would not be reduced to 1E-06. Routing of the adit discharge water to an infiltration gallery would eliminate ingestion of the water, which exceeds both human health and aquatic life standards.

Soil ingestion/dust inhalation of arsenic, lead and manganese would be reduced to below risk-based cleanup goals. Carcinogenic risk from soil ingestion/dust inhalation of arsenic would not be reduced to 1E-06.

Protection of the environment would generally be achieved under this alternative. Prevention of ecological exposures via exposure to water, sediment, and soil sources would be achieved to the extent practicable: deer exposure to lead via ingestion of tailings salts; plant phytotoxicity to arsenic, cadmium, copper, lead, manganese and zinc; acute exposure of aquatic life to arsenic, cadmium, copper, lead and zinc via surface water; and aquatic life exposure to cadmium and zinc via sediment would be reduced to risk-based cleanup levels. Since the waste sources would be removed from the vicinity of Dog Creek, arsenic, lead and zinc concentrations in the stream sediment would be reduced to levels consistent with background as existing sediments are either diluted by mixing with natural sediment or through bedload dispersion downstream, however, these concentrations may not be reduced below risk-based cleanup goals. A risk reduction achievement matrix for the various pathways and contaminants, identified in the baseline human health risk assessment and the ecological risk assessment, is shown in Table 8-18.

8.7.2 Compliance with ARARs

With the exception of lead and manganese, contaminant-specific ARARs are expected to be met when implementing this alternative. Table 8-19 shows that drinking water MCLs and/or HHS for arsenic, cadmium, copper, lead and zinc and ambient water quality criteria for arsenic and zinc are achieved in Dog Creek under this alternative. This is based on the assumption that elevated levels of these contaminants in surface water are attributed to the presence of contaminated sediments in Dog Creek and that sediments will eventually be sufficiently diluted such that they do not cause significant metals loading to Dog Creek. Implementation of this alternative will prevent further erosion of tailings into Dog Creek. Drinking water MCLs and/or HHS for manganese and ambient water quality criteria for lead are not achieved under this alternative. Background water quality exceeds MCLs and/or HHS for manganese and exceeds CALS for lead. However, cleanup below background concentrations is not considered achievable. Ambient water quality standards for cadmium and copper may be achieved; however, this is unknown because the laboratory detection limit for these elements was greater than the water quality standard.

Cadmium, manganese and zinc exceed Federal MCLs or Montana HHS criteria and cadmium, copper and zinc exceed acute and chronic and lead exceeds chronic aquatic life standards in the discharge from the adit at waste rock pile WR1A. Under this alternative, it is proposed that the adit discharge be collected and discharged to a subsurface infiltration gallery. The adit discharge currently flows into the unnamed tributary to Dog Creek and flows over waste rock pile WR1A. Subsurface disposal of the adit discharge will effectively eliminate the direct exposure pathway under a recreational risk scenario (i.e., hikers, etc. drinking directly from the adit). However, this scenario is not necessarily protective of ground water resources. Ground water was not characterized during the site characterization.

Table 8-18. Risk Reduction Achievement Matrix for Alternative 7b

		Arsenic		Cadmium		Copper		Lead		Manganese		Zinc	
Exposure Pathway	**Risk Level**	**Cleanup Goal**	**Achieve Goal**	**Cleanup Goal**	**Achieve Goal**	**Cleanup Goal**	**Achieve Goal**	**Cleanup Goal**	**Achieve Goal**	**Cleanup Goal**	**Achieve Goal**	**Cleanup Goal**	**Achieve Goal**
Human Risk:													
Water Ingestion/Fish Ingestion Pathway (ug/l)	HQ=1	36.7	Yes					165	Yes	33.7	No		
	Carc. 1E-06	0.158	No										
	Carc. 1E-05	1.58	No										
	Carc. 1E-04	15.8	Yes										
Soil Ingestion/Dust Inhalation Pathway (mg/Kg)	HQ=1	323	Yes					2200	Yes	1330	Yes		
	Carc. 1E-06	1.39	No										
	Carc. 1E-05	13.9	No										
	Carc. 1E-04	139	Yes										
Ecological Risk Scenario:	EQ=1												
Deer - Tailings Salt Ingestion (mg/Kg)	LOAEL	NA		NA		NA		314	Yes	NA		NA	
Plant Phytotoxicity - Soil (mg/Kg)	Max Phytotox.	50	Yes	8	Yes	125	Yes	400	Yes	3000	Yes	400	Yes
Aquatic Life - Water (ug/l)	AALS	340	Yes	2.1	Yes	14	Yes	81.6	Yes	NA		120	Yes
Aquatic Life - Sediment (mg/Kg)	PSQC	85	No	9	Yes	390	Yes	110	No	NA		270	No

Notes: NA - Not Applicable
LOAEL - Lower observed adverse effect level
AALS - Freshwater Acute Aquatic Life Standards (DEQ, 2002). Hardness = 100 mg/l $CaCO_3$ for hardness dependent elements.
PSQC - Proposed Sediment Quality Criteria

Table 8-19. Water Quality ARARs Attainment for Alternative 7b

	Arsenic		Cadmium		Copper		Lead		Manganese		Zinc	
	Cleanup Goal	**Achieve Goal**	**Cleanup Goal**	**Achieve Goal**	**Cleanup Goal**	**Achieve Goal**	**Cleanup Goal**	**Achieve Goal**	**Cleanup Goal**	**Achieve Goal**	**Cleanup Goal**	**Achieve Goal**
Drinking Water MCL/HHS	18	Yes	5	Yes	1300	Yes	15	Yes	50	No	2000	Yes
Aquatic Life CALS	150	Yes	0.27	Unk	9.3	Unk	3.2	No	NA		119.8	Yes

HHS - Human Health Standards for Surface Water (DEQ, 2002)
MCL - Maximum Contaminant Level Drinking Water Regulations and Health Advisories, (EPA, 1993)
CALS - Freshwater Chronic Aquatic Life Standards (DEQ, 2002)
Water concentrations in ug/L.
CALS based on water hardness of 100 mg/L.
Unk - Unknown. Cleanup goal is less than the detection limit.

Implementation of this alternative is also expected to satisfy air quality regulations because the repository cap and vegetation cover would stabilize the contaminant sources and inhibit fugitive emissions. The tailings have the highest potential for fugitive emissions based on grain size.

Location-specific ARARs are expected to be met in the implementation of this alternative. Contacts with the appropriate agencies and acquisition of required permits related to streambeds, floodplains, and archaeological/paleontological resources would be completed.

Action-specific ARARs are expected to be met including the hydrological regulations contained in the Strip and Underground Mine Reclamation Act. The tailings and waste rock materials of concern are derived from the beneficiation and extraction of ores and are therefore exempt from federal regulation under the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. 6921 (b) (3) (A)(iii)(1994) as a hazardous waste. Mine and mill wastes are also excluded under the Montana Solid Waste Management Act (75-10-214 (1)(b) MCA. Any temporary stream diversions for construction activities will require coordination with the Montana Department of Fish, Wildlife, and Parks, The U.S. Army Corps of Engineers, the Montana Department of Natural Resources and Conservation, and the Lewis & Clark County Conservation District. Revegetation requirements contained in the Surface Mining and Control Reclamation Act would be met. State of Montana air quality regulations related to dust suppression and control during construction activities will be met using water sprays where applicable, i.e. excavation areas in the tailings and waste rock and haul roads with heavy vehicular traffic.

Occupational Safety and Health Administration (OSHA) requirements would be met by requiring appropriate safety training for all on-site workers during the construction phase. Site activities would be conducted under the guidance of a Health and Safety Plan for the site as per OSHA 29 CFR 1910.120. Site personnel will have completed 40-hour hazardous waste operations and emergency response training and would be current on the 8-hour annual refresher training as required by OSHA.

8.7.3 Long-Term Effectiveness and Permanence

This alternative would reduce contaminant mobility at the site by removing the highest risk, solid media contaminant sources and disposing of these wastes in an engineered repository. The tailings, waste rock and impacted soil would be encapsulated in an engineered repository that would effectively isolate this waste and reduce contaminant mobility. Periodic inspections and maintenance would ensure the long-term stability of the repository.

8.7.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Reduction of contaminant mobility is the primary objective of this alternative. The volume or toxicity of the contaminants in the tailings and waste rock would not be physically nor chemically reduced. The excavation of the tailings and waste rock from the drainage area would reduce the contaminant mobility by moving the waste to a secure location. The primary waste sources of concern (tailings and waste rock piles) would be encapsulated in an engineered structure and physical location which is protected from erosion and water infiltration problems.

8.7.5 Short-Term Effectiveness

It is anticipated that construction activities related to the implementation of this alternative would be completed in one construction season. Impacts associated with construction activities would generally be less than 120 days and should not significantly impact human health nor the environment. On-site workers would be protected by following a site specific Health and Safety Plan, employing appropriate personal protective equipment and by following proper operating and safety procedures. However, short term air quality impacts to the immediate environment may occur due to the relatively large volume of waste excavation and hauling. Control of fugitive dust may require the use of water sprays. Short-term impacts to the surrounding community are expected to be minimal due to the location of the project site. The only foreseen short-term impact to the surrounding community would involve increased vehicle traffic, with associated safety hazards and dust generation, on roads in the vicinity of the waste sources and the repository.

8.7.6 Implementability

This alternative is both technically and administratively feasible. Waste removal, repository construction, and establishing vegetation are readily implementable using conventional construction techniques. Key project components, such as the availability of equipment, materials, and construction expertise, are present and would aid in the timely implementation and successful execution of the proposed project.

8.7.7 Costs

The total present-worth cost for this alternative has been estimated at $3,461,938 which represents the removal of the tailings, waste rock and impacted soil to a constructed modified RCRA repository. Table 8-20 presents the cost details associated with implementing this alternative. The total cost includes the present-worth value of 30 years of annual maintenance and monitoring costs in addition to capital costs.

<u>Conceptual Design and Assumptions</u>

The repository area was selected largely because it is one of the only areas in the vicinity of the project that is relatively open and flat. The base of the repository would be constructed on a bench above Dog Creek, and keyed into the hillside to the east. This area comprises roughly 5 acres that appear to be appropriate for the construction of a repository. The proposed repository site is located on a narrow bench above Dog Creek, and would be constructed against the existing hillside on the east side of Dog Creek. The repository area has been logged in the past and has abundant tree stumps that would require removal prior to installation of the base GCL liner.

A considerable amount of heavy equipment/machinery would be necessary to efficiently implement these alternatives. To construct the repository and load out the waste material, as well as construct runon/runoff control structures, equipment requirements would include, but not be limited to, multiple bulldozers, front end loaders and excavators. Haul trucks or scrapers would also be required to transport and deposit the contaminated material in the constructed repository. The field procedure would involve improving the existing roads from the tailings and

Table 8-20. Preliminary Cost Estimate for Alternative 7b: On-Site Disposal of Tailings and Waste Rock in a Constructed Modified RCRA Repository

Task	Quantity	Units	Unit $	Cost $	Comment
Mobilization, Bonding & Insurance	1	L.S.	201,171	$201,171	8%
Logistics					
Access Road Improvements	15,500	LF	1.00	$15,500	
Site Clearing/Preparation	27.83	Ac	2,000	$55,660	
Dog Creek Stream Diversions	6,700	LF	25.00	$167,500	
Unnamed Tributary Stream Diversion	600	LF	25.00	$15,000	
Dewater Ponds	1	LS	10,000	$10,000	
Debris Removal and Onsite Disposal	1	LS	15,000	$15,000	
Repository Construction					
Cover Soil Removal and Stockpiling	12,130	CY	2.00	$24,260	
Repository Base Grading	4.92	Ac	2,000	$9,831	
Install Geotextile Cushion	23,800	SY	3.00	$71,400	
Geosynthetic Clay Liner	23,800	SY	4.50	$107,100	
Waste Load, Haul & Dump					
Tailings	70,650	CY	4.00	$282,600	
Dog Creek Floodplain Tailings	7,510	CY	6.00	$45,060	
Impacted Soil	33,830	CY	4.00	$135,320	
Bald Butte Waste Rock	2,874	CY	4.00	$11,496	
Devon/Sterling and Albion Waste Rock	32,940	CY	7.00	$230,580	
Waste Grading and Compaction	147,804	CY	2.00	$295,608	
Repository Cap Construction					
Install Geotextile Cushion	24,250	SY	3.00	$72,750	
Geosynthetic Clay Liner	24,250	SY	4.50	$109,125	
Geocomposite Drainage Layer	24,250	SY	4.50	$109,125	
Cover Soil	12,130	CY	2.00	$24,260	
Stream Channel Reconstruction	7,100	LF	80.00	$568,000	
Water Diversion/Runon Controls					
Run-on Control Ditch	1,000	LF	2.00	$2,000	
Adit Discharge Infiltration Gallery	1	LS	10,000	$10,000	
Grade Native Soil Dams	7,200	CY	2	$14,400	
Revegetation					
Seed/Fertilize	27.83	Ac	1,000	$27,830	
Mulch	27.83	Ac	1,000	$27,830	
Fencing					
Barbed-wire Fence	17,200	LF	2.50	$43,000	
Repository Fence	2,400	LF	6.00	$14,400	
Subtotal				$2,715,806	
Construction Oversight	15%			$407,371	
Subtotal Capital Costs				$3,123,177	
Contingency	10%			$312,318	
TOTAL CAPITAL COSTS				$3,435,495	
POST CLOSURE MONITORING AND MAINTENANCE COSTS					
Inspections	1	/Year	250	$250	
Sampling & Analysis	4	/Year	200	$800	
Maintenance	1	L.S.	1500	$1,500	
Subtotal				$2,550	
Contingency	10%			$255	
TOTAL ANNUAL O&M COST				$2,805	
TOTAL CAPITAL COSTS				$3,435,495	
PRESENT WORTH O&M COST	30	yrs @	10%	$26,442	
TOTAL PRESENT WORTH COST				$3,461,938	

waste rock pile areas to the repository area to a one lane haul road with turnouts to allow unobstructed access for heavy equipment. The number of loaders, haul trucks and/or scrapers would be maximized to the extent possible to reduce the overall time required to complete the project's construction phase.

Removal of the Bald Butte millsite tailings piles would require the construction of temporary diversions of Dog Creek around tailings piles TP-1, TP-2 and TP-3; tailings pile TP-5; and tailings pile TP-6 to facilitate the removal of tailings. After the repository construction, waste excavation, and waste placement are complete, the excavated areas would be revegetated. Cover/fill soil may be required in the excavated areas to level and contour the areas to match the surrounding terrain. It is assumed that soil from the repository excavation would be stockpiled and used for cover soil on the repository. Native soil from the TP-1 and TP-2 dams would be graded onto the excavation source areas prior to revegetation. It is possible that a pond could be reconstructed in the area of the existing Pond 2 (Figure 3-2) to continue the current level of recreational opportunities. If a pond is reconstructed, the native soil from the TP-1 and TP-2 dams would be used to construct the pond dam.

The seed beds would be prepared using conventional agricultural plowing. Seeding would likely take place during the fall of the year. The seed mixture and fertilizer would be applied simultaneously to the prepared seed beds via drill application. Mulch would be applied to promote temporary protection of exposed erodible surfaces. Wheat or barley straw mulch (certified weed-free) would be applied over the excavated areas and the repository cap with a tow spreader or pneumatic spreader utilizing tucking/crimping as the anchoring mechanism. A runon/runoff control ditch would be constructed in the area of the repository to divert runoff away from the repository cap. Barbed-wire fencing would be placed around the excavated waste source areas to allow the establishment of vegetation without interference from livestock. A woven-wire fence would be constructed around the repository to limit access.

The general construction steps for implementing Alternative 7b are as follows:

- improving access roads from the waste source areas to the repository;
- site clearing, preparation and debris removal;
- dewatering of the two ponds in the vicinity of tailings pile TP-1 to facility tailings removal and site reclamation;
- preparation of the repository base, including tree, stump and rock removal and recovery and stockpiling of cover soil;
- placement of the repository base GCL liner;
- excavation, loading, hauling, placement, grading and compaction of tailings from tailings piles TP-1 through TP-6;
- excavation, loading, hauling, placement, grading and compaction of impacted native soils from beneath tailings area;
- excavation, loading, hauling, placement, grading and compaction of waste rock from waste rock piles WR-1 through WR-4 and WR1A through WR3A;

- installation of the cap GCL liner and geocomposite drainage layer;
- placement and grading of stockpiled cover soil on the repository;
- constructing surface water diversion ditches strategically located to control water runon in the vicinity of the repository;
- reconstruction of the Dog Creek stream channel in the vicinity of tailings piles TP-1 through TP-6;
- grading of native soil from the TP-1 and TP-2 dams onto the excavated source areas;
- reconstruction of the unnamed tributary of Dog Creek through a portion waste rock pile WR1A;
- diversion of adit discharge water to a subsurface infiltration gallery to eliminate exposure by direct contact;
- establishing vegetation on the repository and excavated waste area by seeding and fertilizing;
- mulching of the seeded areas;
- constructing a 4-strand, barbed-wire fence around the perimeter of the excavated source areas; and
- construction of a woven-wire fence around the repository.

8.8 ALTERNATIVE 7c: ON-SITE DISPOSAL OF TAILINGS AND WASTE ROCK IN A CONSTRUCTED UNLINED REPOSITORY WITH A MULTI-LAYERED CAP

The reclamation strategy for Alternative 7b involves removing all mill tailings, waste rock and impacted soil and disposing these wastes in a constructed unlined repository with a multi-layered cap. The repository would consist of a composite, multi-layered, lined cap overlying the waste. Assuming that the waste sources are deposited in an area of approximately 4.92 acres, the total height of the repository would be approximately 64 feet, with a maximum waste thickness of approximately 46 feet, in order to achieve a 3:1 side slope design in the final cap.

The flowing adit at waste rock pile WR1A (sample GW1) exceeds Federal MCLs and Montana HHS for Cd (18 ug/L) and Mn (310 ug/L), and Montana HHS for Zn (3,550 ug/l). In addition, Cd, Cu and Zn exceed acute and chronic ALS and Pb exceeds chronic ALS in the mine adit discharge water. The underground workings are the most likely source of metals in the adit discharge. Sealing the adits to stop the discharge is not considered a reliable control measure because the flow will likely build up in the extensive underground workings and emerge uncontrolled from another location. Based on the above discussion, there is no effective means to control the discharge without the use of high-cost, high-maintenance treatment systems. Long-term treatment of the adit discharge water is considered cost prohibitive and infeasible.

Under Alternative 7c, the adit discharge water would be collected near the adit opening and conveyed to an infiltration gallery in the valley floor where it will infiltrate into the alluvium. The purpose of the infiltration gallery is to eliminate the potential ingestion of the adit discharge water.

The HELP model was used to simulate the unlined repository with a multi-layered cap scenario. Based on representative soil properties for the 1.5-foot cover soil, geocomposite drainage layer, geosynthetic clay liner, and an average of 17.9 feet of mine/mill waste, the predicted infiltration of water through the tailings is an average of 0.00063 inches per year over a 30-year period. This is equivalent to 0.004 percent of the average annual precipitation of 15.94 inches. An average of 14.498 inches of water per year is predicted to be lost through evapotranspiration, which is equivalent to 90.931 percent of the average annual precipitation. Surface water runoff accounts for a loss of 1.196 inches per year or 7.500 percent of precipitation. Lateral drainage from the geocomposite drainage layer accounts for a loss of 0.160 inches of water per year or 1.005 percent of precipitation. The remaining 0.561 percent of precipitation is accounted for by changes in water storage in the cover soil and tailings layers. The 0.00063 inches per year over the 4.92 acre repository area that is predicted to percolate from the bottom of the repository is equal to a discharge rate of 0.228 gallons per day over a 30 year period.

8.8.1 Overall Protection of Human Health and the Environment

This alternative provides control of direct exposure to the contaminated materials and reduction in risk to human health and the environment. It prevents further erosion and migration of contaminants from tailings source areas. Existing sediment in Dog Creek is not removed in this alternative, however, existing stream sediments should be diluted by mixing with natural sediment or through bedload dispersion downstream to achieve risk-based cleanup goals based on existing background levels.

Placing the wastes into a repository would prevent exposure by direct contact. Exposure to arsenic and lead via ingestion of water/fish is expected to be reduced to below risk-based cleanup goals since further erosion of contaminated sediments into Dog Creek would be prevented. Manganese exposure via the fish ingestion pathway would be reduced to levels consistent with background water quality, but would not achieve risk-based cleanup goals. Cleanup below background concentrations is not considered achievable. Carcinogenic risk from ingestion of arsenic via ingestion of water/fish would not be reduced to 1E-06. Routing of the adit discharge water to an infiltration gallery would eliminate ingestion of the water, which exceeds both human health and aquatic life standards.

Soil ingestion/dust inhalation of arsenic, lead and manganese would be reduced to below risk-based cleanup goals. Carcinogenic risk from soil ingestion/dust inhalation of arsenic would not be reduced to 1E-06.

Protection of the environment would generally be achieved under this alternative. Prevention of ecological exposures via exposure to water, sediment, and soil sources would be achieved to the extent practicable: deer exposure to lead via ingestion of tailings salts; plant phytotoxicity to arsenic, cadmium, copper, lead, manganese and zinc; acute exposure of aquatic life to arsenic, cadmium, copper, lead and zinc via surface water; and aquatic life exposure to cadmium and zinc via sediment would be reduced to risk-based cleanup levels. Since the waste sources would be removed from the vicinity of Dog Creek, arsenic, lead and zinc concentrations in the stream sediment would be reduced to levels consistent with background as existing sediments are either diluted by mixing with natural sediment or through bedload dispersion downstream, however, these concentrations may not be reduced below risk-based cleanup goals. A risk reduction achievement matrix for the various pathways and contaminants, identified in the baseline human health risk assessment and the ecological risk assessment, is shown in Table 8-21.

8.8.2 Compliance with ARARs

With the exception of lead and manganese, contaminant-specific ARARs are expected to be met when implementing this alternative. Table 8-22 shows that drinking water MCLs and/or HHS for arsenic, cadmium, copper, lead and zinc and ambient water quality criteria for arsenic and zinc are achieved in Dog Creek under this alternative. This is based on the assumption that elevated levels of these contaminants in surface water are attributed to the presence of contaminated sediments in Dog Creek and that sediments will eventually be sufficiently diluted such that they do not cause significant metals loading to Dog Creek. Implementation of this alternative will prevent further erosion of tailings into Dog Creek. Drinking water MCLs and/or HHS for manganese and ambient water quality criteria for lead are not achieved under this alternative. Background water quality exceeds MCLs and/or HHS for manganese and exceeds CALS for lead. However, cleanup below background concentrations is not considered achievable. Ambient water quality standards for cadmium and copper may be achieved; however, this is unknown because the laboratory detection limit for these elements was greater than the water quality standard.

Cadmium, manganese and zinc exceed Federal MCLs or Montana HHS criteria and cadmium, copper and zinc exceed acute and chronic and lead exceeds chronic aquatic life standards in the discharge from the adit at waste rock pile WR1A. Under this alternative, it is proposed that the adit discharge be collected and discharged to a subsurface infiltration gallery. The adit discharge currently flows into the unnamed tributary to Dog Creek and flows over waste rock pile WR1A. Subsurface disposal of the adit discharge will effectively eliminate the direct exposure pathway under a recreational risk scenario (i.e., hikers, etc. drinking directly from the adit). However, this scenario is not necessarily protective of ground water resources. Ground water was not characterized during the site characterization.

Implementation of this alternative is also expected to satisfy air quality regulations because the repository cap and vegetation cover would stabilize the contaminant sources and inhibit fugitive emissions. The tailings have the highest potential for fugitive emissions based on grain size.

Location-specific ARARs are expected to be met in the implementation of this alternative. Contacts with the appropriate agencies and acquisition of required permits related to streambeds, floodplains, and archaeological/paleontological resources would be completed.

Action-specific ARARs are expected to be met including the hydrological regulations contained in the Strip and Underground Mine Reclamation Act. The tailings and waste rock materials of concern are derived from the beneficiation and extraction of ores and are therefore exempt from federal regulation under the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. 6921 (b) (3) (A)(iii)(1994) as a hazardous waste. Mine and mill wastes are also excluded under the Montana Solid Waste Management Act (75-10-214 (1)(b) MCA. Any temporary stream diversions for construction activities will require coordination with the Montana Department of Fish, Wildlife, and Parks, The U.S. Army Corps of Engineers, the Montana Department of Natural Resources and Conservation, and the Lewis & Clark County Conservation District. Revegetation requirements contained in the Surface Mining and Control Reclamation Act would

Table 8-21. Risk Reduction Achievement Matrix for Alternative 7c

Exposure Pathway	Risk Level	Arsenic Cleanup Goal	Arsenic Achieve Goal	Cadmium Cleanup Goal	Cadmium Achieve Goal	Copper Cleanup Goal	Copper Achieve Goal	Lead Cleanup Goal	Lead Achieve Goal	Manganese Cleanup Goal	Manganese Achieve Goal	Zinc Cleanup Goal	Zinc Achieve Goal
Human Risk:													
Water Ingestion/Fish Ingestion Pathway (ug/l)	HQ=1	36.7	Yes					165	Yes	33.7	No		
	Carc. 1E-06	0.158	No										
	Carc. 1E-05	1.58	No										
	Carc. 1E-04	15.8	Yes										
Soil Ingestion/Dust Inhalation Pathway (mg/Kg)	HQ=1	323	Yes					2200	Yes	1330	Yes		
	Carc. 1E-06	1.39	No										
	Carc. 1E-05	13.9	No										
	Carc. 1E-04	139	Yes										
Ecological Risk Scenario:	EQ=1												
Deer - Tailings Salt Ingestion (mg/Kg)	LOAEL	NA		NA		NA		314	Yes	NA		NA	
Plant Phytotoxicity - Soil (mg/Kg)	Max Phytotox.	50	Yes	8	Yes	125	Yes	400	Yes	3000	Yes	400	Yes
Aquatic Life - Water (ug/l)	AALS	340	Yes	2.1	Yes	14	Yes	81.6	Yes	NA		120	Yes
Aquatic Life - Sediment (mg/Kg)	PSQC	85	No	9	Yes	390	Yes	110	No	NA		270	No

Notes: NA - Not Applicable
LOAEL - Lower observed adverse effect level
AALS - Freshwater Acute Aquatic Life Standards (DEQ, 2002). Hardness = 100 mg/l $CaCO_3$ for hardness dependent elements.
PSQC - Proposed Sediment Quality Criteria

Table 8-22. Water Quality ARARs Attainment for Alternative 7c

	Arsenic Cleanup Goal	Arsenic Achieve Goal	Cadmium Cleanup Goal	Cadmium Achieve Goal	Copper Cleanup Goal	Copper Achieve Goal	Lead Cleanup Goal	Lead Achieve Goal	Manganese Cleanup Goal	Manganese Achieve Goal	Zinc Cleanup Goal	Zinc Achieve Goal
Drinking Water MCL/HHS	18	Yes	5	Yes	1300	Yes	15	Yes	50	No	2000	Yes
Aquatic Life CALS	150	Yes	0.27	Unk	9.3	Unk	3.2	No	NA		119.8	Yes

HHS - Human Health Standards for Surface Water (DEQ, 2002)
MCL - Maximum Contaminant Level Drinking Water Regulations and Health Advisories, (EPA, 1993)
CALS - Freshwater Chronic Aquatic Life Standards (DEQ, 2002)
Water concentrations in ug/L.
CALS based on water hardness of 100 mg/L.
Unk - Unknown. Cleanup goal is less than the detection limit.

be met. State of Montana air quality regulations related to dust suppression and control during construction activities will be met using water sprays where applicable, i.e. excavation areas in the tailings and waste rock and haul roads with heavy vehicular traffic.

Occupational Safety and Health Administration (OSHA) requirements would be met by requiring appropriate safety training for all on-site workers during the construction phase. Site activities would be conducted under the guidance of a Health and Safety Plan for the site as per OSHA 29 CFR 1910.120. Site personnel will have completed 40-hour hazardous waste operations and emergency response training and would be current on the 8-hour annual refresher training as required by OSHA.

8.8.3 Long-Term Effectiveness and Permanence

This alternative would reduce contaminant mobility at the site by removing the highest risk, solid media contaminant sources and disposing of these wastes in an engineered repository. The tailings, waste rock and impacted soil would be encapsulated in an engineered repository that would effectively isolate this waste and reduce contaminant mobility. Periodic inspections and maintenance would ensure the long-term stability of the repository.

8.8.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Reduction of contaminant mobility is the primary objective of this alternative. The volume or toxicity of the contaminants in the tailings and waste rock would not be physically nor chemically reduced. The excavation of the tailings from the drainage area would reduce the contaminant mobility by moving the waste to a secure location. The primary waste sources of concern (tailings and waste rock piles) would be encapsulated in an engineered structure and physical location which is protected from erosion and water infiltration problems.

8.8.5 Short-Term Effectiveness

It is anticipated that construction activities related to the implementation of this alternative would be completed in one construction season. Impacts associated with construction activities would generally be less than 120 days and should not significantly impact human health nor the environment. On-site workers would be protected by following a site specific Health and Safety Plan, employing appropriate personal protective equipment and by following proper operating and safety procedures. However, short term air quality impacts to the immediate environment may occur due to the relatively large volume of waste excavation and hauling. Control of fugitive dust may require the use of water sprays. Short-term impacts to the surrounding community are expected to be minimal due to the location of the project site. The only foreseen short-term impact to the surrounding community would involve increased vehicle traffic, with associated safety hazards and dust generation, on roads in the vicinity of the waste sources and the repository.

8.8.6 Implementability

This alternative is both technically and administratively feasible. Waste removal, repository construction, and establishing vegetation are readily implementable using conventional construction techniques. Key project components, such as the availability of equipment, materials, and construction expertise, are present and would aid in the timely implementation and successful execution of the proposed project.

8.8.7 Costs

The total present-worth cost for this alternative has been estimated at $3,218,071 which represents the removal of the tailings, waste rock and impacted soil to a constructed unlined repository with a multi-layered cap. Table 8-23 presents the cost details associated with implementing this alternative. The total cost includes the present-worth value of 30 years of annual maintenance and monitoring costs in addition to capital costs.

Conceptual Design and Assumptions

The repository area was selected largely because it is one of the only areas in the vicinity of the project that is relatively open and flat. The base of the repository would be constructed on a bench above Dog Creek, and keyed into the hillside to the east. This area comprises roughly 5 acres that appear to be appropriate for the construction of a repository. The proposed repository site is located on a narrow bench above Dog Creek, and would be constructed against the existing hillside on the east side of Dog Creek. The repository area has been logged in the past and has abundant tree stumps that would require removal prior to waste placement.

A considerable amount of heavy equipment/machinery would be necessary to efficiently implement these alternatives. To construct the repository and load out the waste material, as well as construct runon/runoff control structures, equipment requirements would include, but not be limited to, multiple bulldozers, front end loaders and excavators. Haul trucks or scrapers would also be required to transport and deposit the contaminated material in the constructed repository. The field procedure would involve improving the existing roads from the tailings and waste rock pile areas to the repository area to a one lane haul road with turnouts to allow unobstructed access for heavy equipment. The number of loaders, haul trucks and/or scrapers would be maximized to the extent possible to reduce the overall time required to complete the project's construction phase.

Removal of the Bald Butte millsite tailings piles would require the construction of temporary diversions of Dog Creek around tailings piles TP-1, TP-2 and TP-3; tailings pile TP-5; and tailings pile TP-6 to facilitate the removal of tailings. After the repository construction, waste excavation, and waste placement are complete, the excavated areas would be revegetated. Cover/fill soil may be required in the excavated areas to level and contour the areas to match the surrounding terrain. It is assumed that soil from the repository excavation would be stockpiled and used for cover soil on the repository. Native soil from the TP-1 and TP-2 dams would be graded onto the excavation source areas prior to revegetation. It is possible that a pond could be reconstructed in the area of the existing Pond 2 (Figure 3-2) to continue the current level of recreational opportunities. If a pond is reconstructed, the native soil from the TP-1 and TP-2 dams would be used to construct the pond dam.

The seed beds would be prepared using conventional agricultural plowing. Seeding would likely take place during the fall of the year. The seed mixture and fertilizer would be applied simultaneously to the prepared seed beds via drill application. Mulch would be applied to

Table 8-23. Preliminary Cost Estimate for Alternative 7c: On-Site Disposal of Tailings and Waste Rock in a Constructed Unlined Repository with a Multi-Layered Cap

Task	Quantity	Units	Unit $	Cost $	Comment
Mobilization, Bonding & Insurance	1	L.S.	186,891	$186,891	8%
Logistics					
Access Road Improvements	15,500	LF	1.00	$15,500	
Site Clearing/Preparation	27.83	Ac	2,000	$55,660	
Dog Creek Stream Diversions	6,700	LF	25.00	$167,500	
Unnamed Tributary Stream Diversion	600	LF	25.00	$15,000	
Dewater Ponds	1	LS	10,000	$10,000	
Debris Removal and Onsite Disposal	1	LS	15,000	$15,000	
Repository Construction					
Cover Soil Removal and Stockpiling	12,130	CY	2.00	$24,260	
Repository Base Grading	4.92	Ac	2,000	$9,831	
Waste Load, Haul & Dump					
Tailings	70,650	CY	4.00	$282,600	
Dog Creek Floodplain Tailings	7,510	CY	6.00	$45,060	
Impacted Soil	33,830	CY	4.00	$135,320	
Bald Butte Waste Rock	2,874	CY	4.00	$11,496	
Devon/Sterling and Albion Waste Rock	32,940	CY	7.00	$230,580	
Waste Grading and Compaction	147,804	CY	2.00	$295,608	
Repository Cap Construction					
Install Geotextile Cushion	24,250	SY	3.00	$72,750	
Geosynthetic Clay Liner	24,250	SY	4.50	$109,125	
Geocomposite Drainage Layer	24,250	SY	4.50	$109,125	
Cover Soil	12,130	CY	2.00	$24,260	
Stream Channel Reconstruction	7,100	LF	80.00	$568,000	
Water Diversion/Runon Controls					
Run-on Control Ditch	1,000	LF	2.00	$2,000	
Adit Discharge Infiltration Gallery	1	LS	10,000	$10,000	
Grade Native Soil Dams	7,200	CY	2	$14,400	
Revegetation					
Seed/Fertilize	27.83	Ac	1,000	$27,830	
Mulch	27.83	Ac	1,000	$27,830	
Fencing					
Barbed-wire Fence	17,200	LF	2.50	$43,000	
Repository Fence	2,400	LF	6.00	$14,400	
Subtotal				$2,523,026	
Construction Oversight	15%			$378,454	
Subtotal Capital Costs				$2,901,480	
Contingency	10%			$290,148	
TOTAL CAPITAL COSTS				$3,191,628	
POST CLOSURE MONITORING AND MAINTENANCE COSTS					
Inspections	1	/Year	250	$250	
Sampling & Analysis	4	/Year	200	$800	
Maintenance	1	L.S.	1500	$1,500	
Subtotal				$2,550	
Contingency	10%			$255	
TOTAL ANNUAL O&M COST				$2,805	
TOTAL CAPITAL COSTS				$3,191,628	
PRESENT WORTH O&M COST	30	yrs @	10%	$26,442	
TOTAL PRESENT WORTH COST				$3,218,071	

promote temporary protection of exposed erodible surfaces. Wheat or barley straw mulch (certified weed-free) would be applied over the excavated areas and the repository cap with a tow spreader or pneumatic spreader utilizing tucking/crimping as the anchoring mechanism. A runon/runoff control ditch would be constructed in the area of the repository to divert runoff away from the repository cap. Barbed-wire fencing would be placed around the excavated waste source areas to allow the establishment of vegetation without interference from livestock. A woven-wire fence would be constructed around the repository to limit access.

The general construction steps for implementing Alternative 7c are as follows:

- improving access roads from the waste source areas to the repository;
- site clearing, preparation and debris removal;
- dewatering of the two ponds in the vicinity of tailings pile TP-1 to facility tailings removal and site reclamation;
- preparation of the repository base, including tree, stump and rock removal and recovery and stockpiling of cover soil;
- excavation, loading, hauling, placement, grading and compaction of tailings from tailings piles TP-1 through TP-6;
- excavation, loading, hauling, placement, grading and compaction of impacted native soils from beneath tailings area;
- excavation, loading, hauling, placement, grading and compaction of waste rock from waste rock piles WR-1 through WR-4 and WR1A through WR3A;
- installation of the cap liners and geocomposite drainage layer;
- placement and grading of stockpiled cover soil on the repository;
- constructing surface water diversion ditches strategically located to control water runon in the vicinity of the repository;
- reconstruction of the Dog Creek stream channel in the vicinity of tailings piles TP-1 through TP-6;
- grading of native soil from the TP-1 and TP-2 dams onto the excavated source areas;
- reconstruction of the unnamed tributary of Dog Creek through a portion waste rock pile WR1A;
- diversion of adit discharge water to a subsurface infiltration gallery to eliminate exposure by direct contact;
- establishing vegetation on the repository and excavated waste area by seeding and fertilizing;
- mulching of the seeded areas;

- constructing a 4-strand, barbed-wire fence around the perimeter of the excavated source areas; and

- construction of a woven-wire fence around the repository.

9.0 COMPARATIVE ANALYSIS OF RECLAMATION ALTERNATIVES

This section provides a comparison of the reclamation alternatives retained for the Bald Butte Millsite and Devon/Sterling and Albion Mines project. The comparison focuses mainly on the following criteria: 1) the relative protectiveness of human health and the environment provided by the alternatives; 2) the long-term effectiveness provided by the alternatives; and 3) the estimated attainment of ARARs for each alternative. Qualitative comparisons are used to contrast the two threshold criteria of "overall protection of human health and the environment" and "compliance with ARARs" for each alternative. The primary balancing criteria are also compared, although, the evaluation of each of these criteria is very similar due to the technical similarities in the alternatives themselves, with the exception of costs. Table 9-1 presents a summary of the alternatives with respect to the first eight evaluation criteria.

Alternative 1 - No Action is not considered any further for this alternative would not address any of the environmental concerns raised for the site and would not meet contaminant-specific ARARs.

Alternative 3, which addresses waste rock only at the Devon/Sterling and Albion Mines, is not considered to be a stand-alone reclamation alternative. This alternative would provide for partial removal of waste rock pile WR1A and removal of WR3A so that they are no longer in contact with the unnamed tributary to Dog Creek. Alternative 3 does not provide any significant reduction in exposure risk for the contaminants identified at the site, however, the risk assessment (Section 5) shows that the waste rock piles do not pose a significant risk to human health. However, in-place containment of waste rock could be an attractive alternative when used in conjunction with another alternative.

Alternatives 3, 4a, 4b, 4c, 7a, 7b, and 7c are expected to achieve compliance with action-specific and location-specific ARARs, however, while these alternatives significantly reduce the risks associated with surface water, none of them are expected to satisfy all surface water quality ARARs. None of the alternatives are expected to meet surface water quality ARARs because the chronic aquatic life standard for lead is exceeded in Dog Creek above the site and in the unnamed tributary to Dog Creek above the Devon/Sterling and Albion Mines. Additionally, drinking water ARARs are exceeded for manganese in Dog Creek above the site and in the unnamed tributary to Dog Creek above the Devon/Sterling and Albion Mines. When comparing the exposure pathways of direct contact, surface water and air, each of these alternatives provide similar short-term risk reduction for the contaminants at the site. Alternatives 7a, 7b, and 7c would provide the greater long-term protection of human health and the environment because of the location of the repository away from the stream drainage and the encapsulation of all wastes in an engineered repository. Alternative 3 is not considered a stand-alone alternative and would be implemented in conjunction with Alternative 4a, 4b or 4c. Alternatives 4a, 4b and 4c would provide for the encapsulation of all tailings associated with the project, as well as the Bald Butte Millsite waste rock and a portion of the Devon/Sterling and Albion Mines waste rock.

None of the alternatives reduce the toxicity or volume of the contaminants of concern. The objective of the alternatives is to sever the exposure pathway and to limit the mobility of the contaminants. Limiting contaminant mobility will achieve protection of human health and the environment and will meet applicable ARARs identified for the site.

Table 9-1. Comparative Analysis of Alternatives

Assessment Criteria	Alternative 1: No Action	Alternative 3: Partial In-Place Containment of Devon/Sterling and Albion Waste Rock	Alternative 4a: On-Site Disposal of Tailings and Selected Waste Rock in a Constructed RCRA Repository	Alternative 4b: On-Site Disposal of Tailings and Selected Waste Rock in a Constructed Modified RCRA Repository
Overall Protection of Public Health, Safety and Welfare -	No reduction in risk.	Containment and stabilization of waste rock sources is not expected to reduce human exposure risk as a stand-alone alternative.	Consolidation, encapsulation and stabilization of tailings and WR1-WR4 sources is expected to significantly to reduce human exposure.	Consolidation, encapsulation and stabilization of tailings and WR1-WR4 sources is expected to significantly to reduce human exposure.
Environmental Protectiveness	No protection offered.	Containment and stabilization of waste rock sources is not expected to reduce human exposure risk as a stand-alone alternative.	Encapsulation and stabilization of tailings and WR1-WR4 sources is expected significantly to reduce overall ecological exposure.	Encapsulation and stabilization of tailings and WR1-WR4 sources is expected significantly to reduce overall ecological exposure.
Compliance with ARARs -				
Contaminant Specific	Would not be met.	Background for Mn in unnamed tributary exceed drinking water MCLs/HHS. Background for Pb in unnamed tributary exceeds CALs.	Background for Mn in unnamed tributary exceed drinking water MCLs/HHS. Background for Pb in unnamed tributary exceeds CALs.	Background for Mn in unnamed tributary exceed drinking water MCLs/HHS. Background for Pb in unnamed tributary exceeds CALs.
Location Specific	None apply.	Location-specific ARARs would be met.	Location-specific ARARs would be met.	Location-specific ARARs would be met.
Action Specific	None apply.	Action-specific ARARs would be met, except waste rock would be left unvegetated.	Action-specific ARARs would be met.	Action-specific ARARs would be met.
Long-Term Effectiveness and Performance -				
Magnitude of Risk Reduction	No reduction in CoCs in any environmental media, except by natural degradation/erosion.	Minor reduction in CoCs as a stand-alone alternative except by natural degradation.	High overall risk reduction is expected with tailings and WR1-WR4 removal from Dog Creek and placement in an engineered repository.	High overall risk reduction is expected with tailings and WR1-WR4 removal from Dog Creek and placement in an engineered repository.
Adequacy and Reliability of Controls	No controls over any on-site contamination, no reliability.	Minimal as a stand-alone alternative, some reduction via natural revegetation on waste rock piles.	Primary sources of concern will be adequately isolated from human and environmental receptors.	Primary sources of concern will be adequately isolated from human and environmental receptors.
Reduction of Toxicity, Mobility and Volume -				
Treatment Process Used and Materials Treated	None	No treatment, however, removal of waste rock from unnamed tributary to Dog Creek will reduce mobility of CoCs.	No treatment, however, removal and encapsulation of primary sources of concern from near Dog Creek is expected to provide significant reduction in mobility of CoCs for all pathways.	No treatment, however, removal and encapsulation of primary sources of concern from near Dog Creek is expected to provide significant reduction in mobility of CoCs for all pathways.
Volume of Contaminated Materials Treated	No reduction in CoC toxicity, mobility or volume.	No volume actively treated, however, 6,690 cubic yards of waste rock would be removed from the unnamed tribnutary and isolated in the repository.	No volume actively treated, however, 114,864 cubic yards of tailings and waste rock would be removed and isolated in the repository.	No volume actively treated, however, 114,864 cubic yards of tailings and waste rock would be removed and isolated in the repository.
Expected Degree of Reduction	Minimal, via natural degradation only (potential for future increases in mobility of contaminants)	Minimal, via natural degradation only	Volume or toxicity of wastes would not be reduced, however, mobility of CoCs would be significantly reduced.	Volume or toxicity of wastes would not be reduced, however, mobility of CoCs would be significantly reduced.
Short-Term Effectiveness -				
Protection of Community During Remedial Action	Not applicable.	Fugitive emissions control may be required during construction. Minimal impact on community with the exception of increased vehicle traffic on on-site roads.	Fugitive emissions control may be required during construction. Minimal impact on community with the exception of increased vehicle traffic on on-site roads.	Fugitive emissions control may be required during construction. Minimal impact on community with the exception of increased vehicle traffic on on-site roads.
Protection of On-Site Workers During Removal Action	Not applicable.	Expected to be sufficient. Safety hazards likely more prevalent than hazards associated with wastes.	Expected to be sufficient. Safety hazards likely more prevalent than hazards associated with wastes.	Expected to be sufficient. Safety hazards likely more prevalent than hazards associated with wastes.
Environmental Impacts	Same as baseline conditions.	Environmental impacts possible due to waste rock excavation activities near unnamed tributary.	Environmental impacts possible due to tailings and waste rock excavation activities near stream.	Environmental impacts possible due to tailings and waste rock excavation activities near stream.
Time Until Removal Action Objectives are Achieved	Not applicable.	One construction season.	One construction season.	One construction season.
Implementability -				
Ability to Construct and Operate	No construction or operation involved.	Easily implementable.	Easily implementable. Liner installation will require intensive construction QA/QC.	Easily implementable. Liner installation will require intensive construction QA/QC.
Ease of Implementing More Action If Necessary	Not applicable.	Steep slopes and limited space make more action complicated, although it is possible.	Easily implementable if additional armoring or stabilization, etc. determined necessary.	Easily implementable if additional armoring or stabilization, etc. determined necessary.
Availability of Services and Capacities	Not applicable.	Available locally and within state.	Available locally and within state.	Available locally and within state.
Availability of Equipment and Materials	Not applicable.	Available locally and within state.	Available locally and within state.	Available locally and within state.
Estimated Total Present Worth Cost	**$0**	**$230,662**	**$3,843,869**	**$2,858,019**

Table 9-1. Comparative Analysis of Alternatives

Assessment Criteria	Alternative 4c: On-Site Disposal of Tailings and Selected Waste Rock in a Constructed Unlined Repository with a Multi-Layered Cap	Alternative 7a: On-Site Disposal of Tailings and Waste Rock in a Constructed RCRA Repository	Alternative 7b: On-Site Disposal of Tailings and Waste Rock in a Constructed Modified RCRA Repository	Alternative 7c: On-Site Disposal of Tailings and Waste Rock in a Constructed Unlined Repository with a Multi-Layered Cap
Overall Protection of Public Health, Safety and Welfare -	Consolidation, encapsulation and stabilization of tailings and WR1-WR4 sources is expected to significantly to reduce human exposure.	Consolidation, encapsulation and stabilization of tailings and WR1-WR4 sources is expected to significantly to reduce human exposure.	Consolidation, encapsulation and stabilization of tailings and WR1-WR4 sources is expected to significantly to reduce human exposure.	Consolidation, encapsulation and stabilization of tailings and WR1-WR4 sources is expected to significantly to reduce human exposure.
Environmental Protectiveness	Encapsulation and stabilization of tailings and WR1-WR4 sources is expected significantly to reduce overall ecological exposure.	Encapsulation and stabilization of tailings and WR1-WR4 sources is expected significantly to reduce overall ecological exposure.	Encapsulation and stabilization of tailings and WR1-WR4 sources is expected significantly to reduce overall ecological exposure.	Encapsulation and stabilization of tailings and WR1-WR4 sources is expected significantly to reduce overall ecological exposure.
Compliance with ARARs -				
Contaminant Specific	Background for Mn in unnamed tributary exceed drinking water MCLs/HHS. Background for Pb in unnamed tributary exceeds CALs.	Background for Mn in unnamed tributary exceed drinking water MCLs/HHS. Background for Pb in unnamed tributary exceeds CALs.	Background for Mn in unnamed tributary exceed drinking water MCLs/HHS. Background for Pb in unnamed tributary exceeds CALs.	Background for Mn in unnamed tributary exceed drinking water MCLs/HHS. Background for Pb in unnamed tributary exceeds CALs.
Location Specific	Location-specific ARARs would be met.	Location-specific ARARs would be met.	Location-specific ARARs would be met.	Location-specific ARARs would be met.
Action Specific	Action-specific ARARs would be met.	Action-specific ARARs would be met.	Action-specific ARARs would be met.	Action-specific ARARs would be met.
Long-Term Effectiveness and Performance -				
Magnitude of Risk Reduction	High overall risk reduction is expected with tailings and WR1-WR4 removal from Dog Creek and placement in an engineered repository.	High overall risk reduction is expected with tailings and WR1-WR4 removal from Dog Creek and placement in an engineered repository.	High overall risk reduction is expected with tailings and WR1-WR4 removal from Dog Creek and placement in an engineered repository.	High overall risk reduction is expected with tailings and WR1-WR4 removal from Dog Creek and placement in an engineered repository.
Adequacy and Reliability of Controls	Primary sources of concern will be adequately isolated from human and environmental receptors.	Primary sources of concern will be adequately isolated from human and environmental receptors.	Primary sources of concern will be adequately isolated from human and environmental receptors.	Primary sources of concern will be adequately isolated from human and environmental receptors.
Reduction of Toxicity, Mobility and Volume -				
Treatment Process Used and Materials Treated	No treatment, however, removal and encapsulation of primary sources of concern from near Dog Creek is expected to provide significant reduction in mobility of CoCs for all pathways.	No treatment, however, removal and encapsulation of primary sources of concern from near Dog Creek is expected to provide significant reduction in mobility of CoCs for all pathways.	No treatment, however, removal and encapsulation of primary sources of concern from near Dog Creek is expected to provide significant reduction in mobility of CoCs for all pathways.	No treatment, however, removal and encapsulation of primary sources of concern from near Dog Creek is expected to provide significant reduction in mobility of CoCs for all pathways.
Volume of Contaminated Materials Treated	No volume actively treated, however, 114,864 cubic yards of tailings and waste rock would be removed and isolated in the repository.	No volume actively treated, however, 147,804 cubic yards of tailings and waste rock would be removed and isolated in the repository.	No volume actively treated, however, 147,804 cubic yards of tailings and waste rock would be removed and isolated in the repository.	No volume actively treated, however, 147,804 cubic yards of tailings and waste rock would be removed and isolated in the repository.
Expected Degree of Reduction	Volume or toxicity of wastes would not be reduced, however, mobility of CoCs would be significantly reduced.	Volume or toxicity of wastes would not be reduced, however, mobility of CoCs would be significantly reduced.	Volume or toxicity of wastes would not be reduced, however, mobility of CoCs would be significantly reduced.	Volume or toxicity of wastes would not be reduced, however, mobility of CoCs would be significantly reduced.
Short-Term Effectiveness -				
Protection of Community During Remedial Action	Fugitive emissions control may be required during construction. Minimal impact on community with the exception of increased vehicle traffic on on-site roads.	Fugitive emissions control may be required during construction. Minimal impact on community with the exception of increased vehicle traffic on on-site roads.	Fugitive emissions control may be required during construction. Minimal impact on community with the exception of increased vehicle traffic on on-site roads.	Fugitive emissions control may be required during construction. Minimal impact on community with the exception of increased vehicle traffic on on-site roads.
Protection of On-Site Workers During Removal Action	Expected to be sufficient. Safety hazards likely more prevalent than hazards associated with wastes.	Expected to be sufficient. Safety hazards likely more prevalent than hazards associated with wastes.	Expected to be sufficient. Safety hazards likely more prevalent than hazards associated with wastes.	Expected to be sufficient. Safety hazards likely more prevalent than hazards associated with wastes.
Environmental Impacts	Environmental impacts possible due to tailings and waste rock excavation activities near stream.	Environmental impacts possible due to tailings and waste rock excavation activities near stream.	Environmental impacts possible due to tailings and waste rock excavation activities near stream.	Environmental impacts possible due to tailings and waste rock excavation activities near stream.
Time Until Removal Action Objectives are Achieved	One construction season.	One construction season.	One construction season.	One construction season.
Implementability -				
Ability to Construct and Operate	Easily implementable. Liner installation will require intensive construction QA/QC.	Easily implementable. Liner installation will require intensive construction QA/QC.	Easily implementable. Liner installation will require intensive construction QA/QC.	Easily implementable. Liner installation will require intensive construction QA/QC.
Ease of Implementing More Action If Necessary	Easily implementable if additional armoring or stabilization, etc. determined necessary.	Easily implementable if additional armoring or stabilization, etc. determined necessary.	Easily implementable if additional armoring or stabilization, etc. determined necessary.	Easily implementable if additional armoring or stabilization, etc. determined necessary.
Availability of Services and Capacities	Available locally and within state.	Available locally and within state.	Available locally and within state.	Available locally and within state.
Availability of Equipment and Materials	Available locally and within state.	Available locally and within state.	Available locally and within state.	Available locally and within state.
Estimated Total Present Worth Cost	**$2,639,973**	**$4,562,890**	**$3,461,938**	**$3,218,071**

The short-term effectiveness is expected to be, for the most part, similar to each of the action alternatives. The alternatives are all technically similar and the construction steps required to implement them are expected to be accomplished in one field construction season of generally less than 120 days. Risk exposure to the community is expected to be minimal, with the exception of increased traffic on the roads in the vicinity of the waste sources and the repository.

On-site workers will be required to have hazardous materials handling training and will be subject to a site specific Health and Safety Plan for their protection. Tailings and waste rock excavation activities in or near the Dog Creek stream channel and floodplain may have some short term impact to the environment, although efforts will be made to minimize the risk by temporary stream diversion. Because each of the alternatives will involve excavation and haulage of significant volumes of tailings or waste rock, localized air quality impacts may occur from fugitive dust emissions. Water sprays will be used to control dust emissions and to minimize dust exposure.

For ease of construction, Alternative 4c implemented in conjunction with Alternative 3 would probably be the easiest alternative to implement because the steepest waste rock at the Devon/Sterling and Albion Mines would be contained in place under Alternative 3 and the repository lining requirements are less than under Alternatives 4a, 4b, 7a and 7b. Alternatives 7a and 7b would be the most technically difficult to implement because of the steepness of the Devon/Sterling and Albion Mine waste rock piles, the increased waste volume to move, the increased haul distance for the waste disposal, and the increased construction quality control for repository construction. Implementation of Alternative 7c would be similar to Alternatives 7a and 7b, except that the liner requirements would be reduced because no base liner would be installed. Alternatives 4a and 4b would be similar to the implementation of Alternative 4c, except that the lining requirements would be more stringent than Alternative 4c.

Due to the large-scale nature of this reclamation project, in conjunction with the technical requirements applicable to installing surface water diversions, heavy equipment operation and grading requirements, only properly trained and experienced contractors/crews utilizing large-capacity equipment should perform the specified work. Small capacity equipment and/or inexperienced contractors and crews would likely prolong the construction phase and may result in increased costs and compromised performance.

Table 9-1 indicates the estimated total costs associated with each alternative. The no action alternative is not considered feasible because it would not adequately address the identified risks to human health and the environment at the site. Alternative 3 is not considered a stand-alone alternative and would be implemented in conjunction with Alternative 4a, 4b or 4c. Of the various action alternatives considered for the site, Alternative 3 is the least costly, and Alternative 7a is the most costly. To compare on an equal basis, the cost of Alternative 3 has been added to the costs of 4a, 4b and 4c for comparison with alternatives 7a, 7b and 7c. The combined estimated costs for Alternative 3 with Alternatives 4a, 4b and 4c are $4,074,530, $3,088,681 and $2,870,635, respectively. Estimated costs for Alternatives 7a, 7b and 7c are $4,562,890, $3,461,938 and $3,218,071, respectively. Direct cost comparisons can be made between Alternatives 3/4a and 7a, Alternatives 3/4b and 7b and Alternatives 3/4c and 7c. The estimated cost for Alternative 7a is $488,360 more than the combined Alternatives 3 and 4a. The estimated cost for Alternative 7b is $373,257 more than the combined Alternatives 3 and 4b. The estimated cost for Alternative 7c is $347,436 more than the combined Alternatives 3 and 4c.

10.0 PREFERRED ALTERNATIVE

The principal waste sources associated with the Bald Butte Millsite and Devon/Sterling and Albion Mines that are contributing to environmental impacts are the mill tailings and waste rock. The mill tailings are elevated in metals/metalloids including: antimony, arsenic, cadmium, copper, lead, manganese, mercury, silver and zinc (concentrations greater than three times background), along with cyanide. The Bald Butte Millsite waste rock is elevated in antimony, arsenic, cadmium, copper, iron, lead, manganese, silver and zinc. The Devon/Sterling and Albion Mines waste rock is elevated in antimony, arsenic, cadmium, copper, lead, silver and zinc.

The greatest risk to human health and the environment from waste sources associated with the Bald Butte Millsite and the Devon/Sterling and Albion Mine sites are the tailings and waste rock piles via the direct contact, surface water and air exposure pathways. Based on the risk assessment, exposure to manganese via ingestion/inhalation of tailings and ingestion of fish, exposure to arsenic and lead via ingestion/inhalation of waste rock, and exposure to arsenic via ingestion of fish are the principal contaminants of concern and exposure pathways for human health. The principal contaminants of concern and ecological exposure pathways are: cadmium and zinc via exposure of aquatic life to surface water; arsenic, cadmium, copper, lead and zinc via exposure of aquatic life to stream sediment; lead via deer ingestion of tailings and waste rock salts; and plant phytotoxicity to arsenic, cadmium, copper, lead and zinc.

Tailings piles TP-1, TP-2, TP-3 and TP-6 and waste rock piles WR-2, WR-3 and WR1A exceeded TCLP regulatory levels for lead. Acid-base accounting results and field evidence indicate that most of the tailings and waste rock are probably not acid generating. ABA and NAG pH data indicate that waste rock pile WR3A is potentially acid generating; however, WR3A comprises only 380 cubic yards of the estimated 147,804 cubic yards of waste and impacted soil. The TCLP results suggest that a repository base liner may be appropriate, while the generally favorable acid-base accounting data support the use of an unlined repository with a multi-layered cap to control water infiltration.

The tailings piles are located in or near the Dog Creek stream drainage. The tailings piles are currently subject to erosion and infiltration of surface water, which contributes metals loading to surface water and stream sediment. Removal of the tailings from the drainage to an engineered repository would provide protection from the existing erosion and infiltration problems with a high degree of overall risk reduction. The unnamed tributary to Dog Creek currently flows over the top of and down the face of waste rock pile WR1A.

Based on the conclusions of the detailed analysis and comparative analysis of alternatives, Alternative 7b - On-Site Disposal of Tailings and Waste Rock in a Constructed Modified RCRA Repository is proposed as the preferred alternative for reclamation of the tailings, waste rock and impacted soil associated with Bald Butte Millsite and Devon/Sterling and Albion Mine sites. This alternative is considered the most appropriate and cost-effective means to reduce risk to human health and the environment to an acceptable level. In summary, the reclamation strategy for Alternative 7b involves removing the tailings, waste rock and impacted native soil associated with the Bald Butte Millsite and Devon/Sterling and Albion Mine sites and disposing these wastes in a modified RCRA repository which includes a single geosynthetic clay liner (without a leachate collection and removal system) and a multi-layered cap. The sources to be disposed in the repository include the tailings piles TP-1 through TP-6, the Vat Leach/Hopper area, the drum disposal area, and the Dog Creek floodplain tailings; waste rock piles WR-1 through WR-4 and WR1A through WR3A; and impacted native soils that exist beneath most of the tailings piles.

The proposed repository would be located in a relatively open and flat area on a bench above Dog Creek, and keyed into the hillside to the east. This area comprises roughly 5 acres that appear to be appropriate for the construction of a repository. The repository area has been logged in the past and has abundant tree stumps that would require removal prior to installation of the base GCL liner.

Removal of the tailings piles and waste rock piles WR1A and WR3A would require the construction of several temporary diversion of Dog Creek and the unnamed tributary to Dog Creek while excavating these waste sources. Dog Creek and its unnamed tributary would be reconstructed in the vicinity of each waste source. The flowing adit at waste rock pile WR1A would be diverted to an infiltration gallery to provide for subsurface disposal of the adit discharge water and to eliminate exposure via direct contact. After the repository construction, waste excavation, and waste placement are complete, the excavated areas would be revegetated. A runon/runoff control ditch would be constructed in the area of the repository to divert runoff away from the repository cap. Barbed-wire fencing would be placed around the excavated waste source areas to allow the establishment of vegetation without interference from livestock. A woven-wire fence would be constructed around the repository to limit access.

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APPENDIX A

DESCRIPTION OF FEDERAL AND STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Table of Contents

1.0 INTRODUCTION

This description of the applicable or relevant and appropriate requirements (ARARs) was compiled from documents describing ARARs for abandoned mine sites that was produced by the Montana Department of Environmental Quality (DEQ) - Mine Waste Cleanup Bureau (MWCB) and other state agencies. These ARARs, along with those prepared by ARCO for the Streamside Tailings Operable Unit (ARCO, 1995) and the Montana DEQ Hazardous Waste Site Cleanup Bureau for mine sites were reviewed and updated by Olympus to develop a listing of potential Federal and State ARARs for the Bald Butte Millsite and the Devon/Sterling and Albion Mines.

Section 121(d)(2) of the CERCLA, 42 United States Code (U.S.C.) § 9621(d)(2), requires that clean-up actions conducted under CERCLA achieve a level or standard of control which at least attains "any standard, requirement, criteria, or limitation under any Federal environmental law... or any [more stringent] promulgated standard, requirement, criteria or limitation under a State environmental or facility siting law... [which] is legally applicable to the hazardous substance concerned or is relevant and appropriate under the circumstances of the release of such hazardous substance or pollutant, or contaminant..." The standards, requirements, criteria, or limitations identified pursuant to this section are commonly referred to as "applicable or relevant and appropriate requirements (ARARs)."

Two general types of clean-up actions are recognized under CERCLA: removal actions and remedial actions. A removal action is an action to abate, prevent, minimize, stabilize, mitigate, or eliminate a release or threat of release. This action is often temporarily taken to alleviate the most acute threats or to prevent further spread of contamination until more comprehensive action can be taken. A remedial action is a thorough investigation, evaluation of alternatives, and determination and implementation of a comprehensive and fully protective remedy for the site.

ARARs may be either "applicable" or "relevant and appropriate" to remedial activities at a site but not both. Applicable requirements are those standards, requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. A remedial action must satisfy all the jurisdictional prerequisites of a requirement for it to be applicable to the specific remedial action at a CERCLA site.

Relevant and appropriate requirements are those standards, requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not "applicable" to hazardous substances, pollutants, contaminants, remedial actions, locations, or other circumstances at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Factors which may be considered in making this determination, when the factors are pertinent, are presented in 40 Code of Federal Regulations (CFR) § 300.400(g)(2). They include, among other considerations, examination of the purpose of the requirement and of the CERCLA action, the medium and substances regulated by the requirement and at the CERCLA site, the actions or activities regulated by the requirement and the remedial action contemplated at the site, and the potential use of resources affected by the requirement and the use or potential use of the affected resource at the CERCLA site.

ARARs are divided into contaminant-specific, location-specific, and action-specific requirements. Contaminant-specific requirements govern the release of materials possessing certain chemical or physical characteristics or containing specific chemical compounds into the environment. Contaminant-specific ARARs generally set human or environmental risk-based criteria and protocol which, when applied to site-specific conditions, result in the establishment of numerical action values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment.

Location-specific ARARs relate to the geographic or physical position of the site, rather than to the nature of site contaminants. These ARARs place restrictions on the concentration of hazardous substances or the conduct of clean-up activities due to their location in the environment.

Action-specific ARARs are usually technology- or activity-based requirements or are limitations on actions taken with respect to hazardous substances. A particular remedial activity will trigger an action-specific ARAR. Unlike chemical- and location-specific ARARs, action-specific ARARs do not, in themselves, determine the remedial alternative. Rather, action-specific ARARs indicate how the selected remedy must be achieved.

Non-promulgated advisories or guidance documents issued by federal or state governments do not have the status of potential ARARs. However, these advisories and guidance documents are "To Be Considered (TBC)" when determining protective clean-up levels. The TBC category consists of advisories, criteria, or guidance that were developed by the U.S. Environmental Protection Agency (EPA), other federal agencies, or states that may be useful in developing CERCLA remedies. These categories may be considered as appropriate in selecting and developing clean-up actions.

As provided by Section 121 of CERCLA, 42 U.S.C. § 9621, only those state standards that are more stringent than any federal standard and that have been identified by the State in a timely manner are appropriately included as ARARs. Some state standards that are potentially duplicative of federal standards are identified here to ensure their timely identification and consideration in the event that they are not identified or retained in the federal ARARs. Duplicative or less stringent standards will be deleted as appropriate when the final determination of ARARs is presented.

CERCLA defines only federal environmental laws and state environmental or facility siting laws as ARARs. Remedial design, implementation, and operation and maintenance must, nevertheless, comply with all other applicable laws, both state and federal. Many such laws, while not strictly environmental or facility siting laws, have environmental impacts. Moreover, applicable laws that are not ARARs because they are not environmental or facility siting laws are not subject to the ARAR waiver provisions, and the administrative, as well as the substantive, provisions of such laws must be observed. A separate list attached to the state ARARs' list is a non-comprehensive identification of other state law requirements, which must be observed during remedial design, remedy implementation, operation, or maintenance.

The description of the federal (Section 2.0) and state (Section 3.0) ARARs that follows includes summaries of legal requirements that in many cases attempt to set out the requirement in a simple fashion useful in evaluating compliance with the requirement. In the event of any inconsistency between the law itself and the summaries in this section, the ARAR is ultimately the requirement as set out in the law, rather than any paraphrase provided here.

The potential Federal and State ARARs, advisories, and guidance that may be useful in reclaiming the Bald Butte Millsite and the Devon/Sterling and Albion Mines are presented below in the following sections.

2.0 FEDERAL ARARS

Potential federal ARARs for the Bald Butte Millsite and the Devon/Sterling and Albion Mines are presented below.

2.1 FEDERAL CONTAMINANT-SPECIFIC ARARS

2.1.1 Clean Water Act (Applicable)

The Federal Clean Water Act (33 U.S.C. §§ 1251-1375) as amended by the Water Quality Act of 1987 (Public Law 100-4 § 103) provides the authority for each state to adopt water quality standards (40 CFR Part 131) designed to protect beneficial uses of each water body and requires each state to designate uses for each water body. EPA regulation requires states to establish antidegradation requirements. EPA has provided guidance to the states for this purpose ("Water Quality Criteria Summary"; Quality Criteria for Water 1986 - Update 2 EPA; May 1, 1987). Pursuant to this authority and the criteria established by Montana water quality regulations (ARM § 17.30.623), Montana established classification standards for discharge into the major river drainages. These classifications are presented in the state ARARs section.

At this time, EPA is relying on the State standards. EPA reserves the right to identify federal water quality criteria as ARARs for this action, if appropriate.

40 CFR Part 122 establishes the National Pollutant Discharge Elimination System (NPDES). The substantive requirements of general permits for storm water discharges from construction are relevant and appropriate. See 57 Fed. Reg. 41236, September 9, 1992. Montana has an EPA approved State program (MPDES) that is discussed in the state ARARs section.

2.1.2 Safe Drinking Water Act (Relevant and Appropriate)

The Safe Drinking Water Act (SDWA) cited at 42 U.S.C. § 300f, et seq. has established the maximum contaminant levels (MCL) for chemicals in drinking water distributed in public water systems. The MCLs are contained in the national Primary and Secondary Drinking Water Regulations (40 CFR Parts 141 and 143). SDWA MCLs are not applicable to the reclamation activities at the site because the groundwater and surface water at the site are not a public water supply. The SDWA MCLs are relevant and appropriate at the site even though the groundwater and surface water are not currently part of a public water system because 1 well has been identified within approximately 2 mile radius of the site and is located in the NW1/4 Section 22, Township 11 North and Range 6 West, Montana Principal Meridian. The Preamble to the National Oil and Hazardous Substance Contingency Plan (NCP) clearly states that the MCLs are relevant and appropriate for groundwater that is a current or potential source of drinking water (55 Fed. Reg. 8750 (March 8, 1990)) and is further supported by requirements of the NCP, 40 CFR, § 300.430(e)(2)(i)(B). MCLs developed under the SDWA generally are ARARs for current or potential drinking water sources.

Standards for potential contaminants of concern at the site are:

Element	MCLs[a] (mg/L)	MT Human Health Standard[b] Surface Water (ug/L)	MT Human Health Standard[b] Groundwater (ug/L)
Antimony	0.006	6	6
Arsenic	0.05	18	20
Cadmium	0.005	5	5
Copper	1.3	1,300	1,300
Lead	0.015	15	15
Manganese	0.05	50	50
Mercury	0.002	0.05	2
Silver	0.1	100	100
Zinc	5	2,000	2,000

Note: [a] = Federal Primary and Secondary Maximum Contaminant Levels in Water
[b] = DEQ WQB Circular WQB-7 (January 2002)

The EPA has granted to the State of Montana primacy in the implementation and enforcement of the Safe Drinking Water Act (SDWA). Thus, the law commonly enforced in Montana is the state law. The state regulations substantially parallel the federal law.

2.1.3 Clean Air Act (Applicable)

Section 109 of the Clean Air Act (42 U.S.C. § 7409) and implementing regulations found at 40 CFR Part 50 set national primary and secondary ambient air quality standards. National primary ambient air quality standards define levels of air quality that are necessary, with an adequate margin of safety, to protect the public health. National secondary ambient air quality standard define levels of air quality that are necessary to protect public welfare from any known or anticipated adverse effects of a pollutant. The standards for particulate matter at 40 CFR § 50.6 are applicable for reclamation alternatives for the Bald Butte Millsite and the Devon/Sterling and Albion Mines, particularly for the earth moving (load, haul, dump), grading, and capping activities. These standards must be met both during the design and implementation phases of the remedial action.

Particulate Matter

The ambient air quality standard for particulate matter of less than or equal to 10 micrometers in diameter (PM-10) is 150 micrograms per cubic meter, 24-hour average concentration; 50 micrograms per cubic meter, annual arithmetic mean for particulate matter of less than or equal to 10 micrometers in diameter.

In addition, state law provides an ambient air quality standard for settled particulate matter. Particulate matter concentrations in the ambient air shall not exceed the 30-day average of 10 grams per square meter. Administrative Rules of Montana (ARM) § 17.8.220 (applicable).

2.1.4 Resource Conservation and Recovery Act (Applicable)

Under 40 CFR Part 261, Subpart A defines the solid wastes (mining-related wastes) which are subject to regulations as hazardous wastes. This requirement is applicable to reclamation alternatives that involve treatment, storage, or disposal of hazardous wastes in a solid waste management unit (such as a surface impoundment, waste pile, land treatment unit, or landfill). The limits specified for ground water protection are the same as the maximum contaminant levels (MCL) for those substances as defined in Section 2.1.2.

2.2 FEDERAL LOCATION-SPECIFIC ARARS

2.2.1 National Historic Preservation Act (Applicable)

This statute, and implementing regulations (16 U.S.C. § 470, 40 CFR § 6.301(b), 36 CFR Part 800), requires federal agencies or federal projects to take into account the effect of any federally assisted undertaking or licensing on any district, site, building, structure, or object that is included in, or eligible for, the Register of Historic Places. Compliance with this ARAR requires consultation with the State Historic Preservation Officer (SHPO), who can identify historic properties and assess whether proposed clean-up actions will impact these resources.

2.2.2 Archeological and Historical Preservation Act (Applicable)

This statute and implementing regulations (16 U.S.C. § 469, 40 CFR § 6.301 (c)) establish requirements for the evaluation and preservation of historical and archaeological data, which may be destroyed through alteration of terrain as a result of a Federal construction project or a federally licensed activity or program. This requires a survey of the site for covered scientific, prehistorical or archaeological artifacts. Preservation of appropriate data concerning the artifacts is hereby identified as an ARAR requirement, to be completed during the implementation of the reclamation activities.

2.2.3 Historic Sites, Buildings and Antiquities Act (Applicable)

This Act (16 U.S.C. §§ 461 et seq.; 40 CFR § 6.301(a)) states that "in conducting an environmental review of a proposed EPA action, the responsible official shall consider the existence and location of natural landmarks using information provided by the National Park Service pursuant to 36 CFR § 62.6(d) to avoid undesirable impacts upon such landmarks." "National natural landmarks" are defined under 36 CFR § 62.2 as:

> National Natural Landmark is an area designated by the Secretary of the Interior as being of national significance to the United States because it is an outstanding example(s) of major biological and geological features found within the boundaries of the United States or its Territories or on the Outer Continental Shelf

Under the Historic Sites Act of 1935, the Secretary of the Interior is authorized to designate areas as National Natural Landmarks for listing on the National Registry of Natural Landmarks.

2.2.4 Protection of Wetlands Order (Applicable)

This requirement (40 CFR Part 6, Appendix A, Executive Order No. 11,990) mandates that Federal agencies and the Potentially Responsible Party (PRP) avoid, to the extent possible, the adverse impacts associated with the destruction or loss of wetlands and to avoid support of new construction in wetlands if a practicable alternative exists. Wetlands are defined as those areas that are inundated or saturated by groundwater or surface water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. For this project, jurisdictional wetland identification has not been performed; however, the site characterization for the site indicates wetlands exist because Dog Creek flows through the tailings and a large pond and associated wetlands vegetation are either underlain by tailings or have tailings eroded into it. Compliance with this ARAR requires consultation with the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service to determine the extent of wetlands and to ascertain the means and measures necessary to mitigate, prevent, and compensate for project related losses of wetlands.

2.2.5 Floodplain Management Order (Applicable)

This requirement (40 CFR Part 6, Appendix A, Executive Order No. 11,988) mandates that federally funded or authorized actions within the 100-year floodplain avoid, to the maximum extent possible, adverse impacts associated with development of a floodplain. Compliance with this requirement is detailed in "Policy on Floodplains and Wetland Assessments for CERCLA Actions," 1985. Specific measures to minimize adverse impacts will be identified following consultation with the appropriate agencies. The Bald Butte Millsite and the Devon/Sterling and Albion Mines are not located within a designated 100-year floodplain.

2.2.6 Fish and Wildlife Coordination Act (Applicable)

This standard (16 U.S.C. §§ 661 et seq., 40 CFR § 6.302(g)) requires that Federal agencies or federally funded projects ensure that any modification of any stream or other water body affected by an action authorized or funded by the Federal agency provides for adequate protection of fish and wildlife resources. Compliance with this ARAR requires consultation with the U.S. Fish and Wildlife Service and the Wildlife Resources Agency of the affected state (State of Montana Department of Fish, Wildlife, and Parks) to ascertain the means and measures necessary to mitigate, prevent, and compensate for project-related losses of wildlife resources and to enhance the resources. Consultation will occur during the public comment period, and specific mitigative measures may be identified in consultation with the appropriate agencies, if alternatives, as developed, will affect a stream.

2.2.7 Endangered Species Act (Applicable)

This statute, and implementing regulations (16 U.S.C. §§ 1531 et seq., 50 CFR § 402 and 40 CFR § 6.302(h)), require that any federal activity or federally authorized activity may not jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify critical habitat. Compliance with this requirement involves consultation with the U.S. Fish and Wildlife Service, resulting in a determination as to whether there are listed or proposed species or critical habitats present, and, if so, whether any proposed activities will impact such wildlife or habitat. At this time no threatened or endangered species or critical habit has been identified on the sites.

2.2.8 Resource Conservation and Recovery Act (Relevant and Appropriate)

The requirements set forth at 40 CFR § 264.18(a) and (b) provide that: a) any hazardous waste facility must not be located within 61 meters (200 feet) of a fault; and b) any hazardous waste facility within the 100-year floodplain must be designed, constructed, operated and maintained to avoid washout. Any discrete disposal or storage facilities which remain on-site as part of remedial alternative must meet these standards.

2.3 FEDERAL ACTION-SPECIFIC ARARS

2.3.1 Surface Mining Control and Reclamation (Relevant and Appropriate)

This Act (30 U.S.C. §§ 1201-1328) and implementing regulations found at 30 CFR Parts 816 and 784 establish provisions designed to protect the environment from the effects of surface coal mining operations, and to a lesser extent, non-coal mining. The regulations require that revegetation be used to stabilize soil covers over reclaimed areas. These requirements are relevant and appropriate to the covering of discrete areas of contamination. They also require that revegetation be done according to a plan which specifies schedules, species which are diverse and effective, planting methods, mulching techniques, irrigation if appropriate, and appropriate soil testing. Reclamation performance standards are currently relevant and appropriate to mining waste sites.

2.3.2 Clean Water Act (Applicable)

40 CFR Part 122 establishes the National Pollutant Discharge Elimination System (NPDES). The substantive requirements of general permits for storm water discharges from construction are relevant and appropriate. See 57 Fed. Reg. 41,236, September 9, 1992. Montana has an EPA approved State program (MPDES) that is discussed in the State ARARs Section.

2.3.3 Resource Conservation and Recovery Act

Criteria for Classification of Solid Waste Disposal Facilities Practices (Applicable)

The criteria contained in 40 CFR Part 257 (Subtitle D) are used in accordance with RCRA guidance in determining which practices pose a reasonable probability of having an adverse effect on human health or the environment. RCRA Subtitle D establishes criteria which are, for the most part, environmental performance standards that are used by states to identify unacceptable solid waste disposal practices or facilities.

Regulation 40 CFR Part 257.3-1(a) states that facilities or practices in the floodplain shall not result in the washout of solid waste so as to pose a hazard to human life, wildlife, or land or water resources.

Regulation 40 CFR Part 257.3-2 provides for the protection of threatened or endangered species.

40 CFR Part 257.3-3 provides that a facility shall not cause the discharge of pollutants into waters of the United States; this includes dredged or fill materials.

40 CFR Part 257.3-4 states that a facility or practice shall not contaminate underground drinking water beyond the solid waste boundary.

Standards Applicable to Transporters of Hazardous Waste (Applicable)

The regulations at 40 CFR Part 263 establish standards that apply to persons that transport hazardous waste within the U.S. If hazardous waste is transported on a rail-line or public highway on-site, or if transportation occurs off-site, these regulations will be relevant and appropriate.

Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities (Relevant and Appropriate)

A. Releases from Solid Waste Management Units (Applicable)

The regulations at 40 CFR 264, Subpart F, establish requirements for groundwater protection for RCRA-regulated solid waste management units (i.e., waste piles, surface impoundments, land treatment units, and landfills). Subpart F provides for three general types of groundwater monitoring: detection monitoring, compliance monitoring and corrective action monitoring. Monitoring is required during the active life of a hazardous waste management unit. At closure, if all hazardous waste, waste residue, and contaminated subsoil is removed, no monitoring is required. If hazardous waste remains, the monitoring requirements continue during the 40 CFR § 264.117 closure period.

B. Closure and Post-Closure (Relevant and Appropriate)

40 CFR Part 264, Subpart G, establishes that hazardous waste management facilities must be closed in such a manner as to: a) minimize the need for further maintenance; and b) control, minimize or eliminate, to the extent necessary, to protect public health and the environment, post-closure escape of hazardous wastes, hazardous constituents, leachate, contaminated run-off or hazardous waste decomposition products to the ground or surface waters or to the atmosphere.

Facilities requiring post-closure care must undertake appropriate monitoring and maintenance actions, control public access, and control post-closure use of the property to ensure that the integrity of the final cover, liner, or containment system is not disturbed. 40 CFR § 264.117. In addition, all contaminated equipment, structures and soil must be properly disposed of or decontaminated unless exempt. 40 CFR § 264.114. A survey plat should be submitted to the local zoning authority and to the EPA Regional Administrator indicting the location and dimensions of landfill cells or other hazardous waste disposal units with respect to permanently surveyed benchmarks. 40 CFR § 264.116. 40 CFR § 264.228(a) requires that at closure, free liquids must be removed or solidified, the wastes stabilized, and the waste management unit covered.

C. Waste Piles (Applicable)

40 CFR Part 264, Subpart L, applies to owners and operators of facilities that store or treat hazardous waste in piles. The regulations require the use of run-on and run-off control systems and collection and hold systems to prevent the release of contaminants from waste piles.

D. Land Treatment (Applicable)

The requirements of 40 CFR Part 264, Subpart M, regulate the management of "land treatment units" that treat or dispose of hazardous waste; these requirements are applicable for any land treatment units established at the site. The owner or operator of a land treatment unit must design treatment so that hazardous constituents placed in the treatment zone are degraded, transformed, or immobilized within the treatment zone. "Hazardous constituents" are those identified in Appendix VIII of 40 CFR Part 261 that are reasonably expected to be in, or derived from, waste placed in or on the treatment zone. Design measures and operating practices must be set up to maximize the success of degradation, transformation, and immobilization processes. The treatment zone is the portion of the unsaturated zone below and including the land surface in which the owner or operator intends to maintain the conditions necessary for effect degradation, transformation, or immobilization of hazardous constituents. The maximum depth of the treatment zone must be no more than 1.5 meters (5 feet) from the initial soil surface and more than one meter (3 feet) above the seasonal high water table.

Subpart M also requires the construction and maintenance of control features that prevent the run-off of hazardous constituents and the run-on of water to the treatment unit. The unit must also be inspected weekly and after storms for deterioration, malfunctions, and improper functioning of wind dispersal control measures.

An unsaturated zone monitoring program must be established to monitor soil and soil-pore liquid to determine whether hazardous constituents migrate out of the treatment zone. Specifications related to the monitoring program are contained in section 264.278. There are no land treatment units proposed for the Bald Butte Millsite and the Devon/Sterling and Albion Mines.

E. Landfills

Regulation 40 CFR Part 264, Subpart N, applies to entities that dispose of hazardous waste in landfills. The regulations specify appropriate liner systems and leachate collection systems for landfills, run-on and run-off management systems, and wind dispersal controls for landfills. These regulations set forth specific requirements for landfill monitoring and inspection, surveying and recordkeeping, and closure and post-closure care. There are no landfills proposed for the Bald Butte Millsite and the Devon/Sterling and Albion Mines.

2.3.4 Hazardous Materials Transportation Act (Applicable)

The Hazardous Materials Transportation Act (49 U.S.C. §§ 5101-5105), as implemented by the Hazardous Materials Regulations (49 CFR Parts 10, 171-177), regulates the transportation of hazardous materials. The regulations apply to any alternatives involving the transport of hazardous waste off-site, on public highways on-site, or by rail.

2.4 OTHER FEDERAL LAWS

2.4.1 Occupational Safety and Health Regulations

The federal Occupational Safety and Health Act (29 USC § 655) regulations found at 29 CFR § 1910 are applicable to worker protection during conduct of RI/FS or remedial activities at hazardous material sites.

3.0 STATE OF MONTANA ARARS

Potential state ARARs for the Bald Butte Millsite and the Devon/Sterling and Albion Mines are presented below.

3.1 MONTANA CONTAMINANT-SPECIFIC ARARS

3.1.1 Montana Water Quality Act (Applicable)

Under the state Water Quality Act, §§ 75-5-101 et seq., MCA, the state has promulgated regulations to preserve and protect the quality of surface waters in the state. These regulations classify state waters according to quality, place restrictions on the discharge of pollutants to state waters and prohibit the degradation of state waters. The requirements listed below are applicable water quality standards with which any remedial action must comply.

ARM 17.30.610(1) (Applicable) provides that specified waters in the Clark Fork River drainage basin which includes the Dog Creek drainage are classified B-1 for water use.

The standards for B-1 classification waters are contained in ARM 17.30.623 (Applicable) of the Montana Water Quality regulations. These standards place limits on fecal coliform content, dissolved oxygen concentration, pH balance, turbidity, water temperature, sediments, solids, oils, and color. Concentrations of toxic and deleterious substances which would remain in the water after conventional treatment cannot exceed MCLs, and concentrations of toxic and deleterious substances cannot exceed Gold Book levels. The B-1 classification standards also provide:

- During periods when the daily maximum water temperature is greater than 60°F, the geometric mean number of organisms in the fecal coliform group must not exceed 200 per 100 milliliters (ml), nor are 10 percent of the total samples during any 30-day period to exceed 400 fecal coliform per 100 ml.

- Dissolved oxygen concentration must not be reduced below the levels given in department Circular WQB-7.

- Induced variation of hydrogen ion concentration (pH) within the range of 6.5 to 8.5 must be less than 0.5 pH unit. Natural pH outside this range must be maintained without change. Natural pH above 7.0 must be maintained above 7.0.

- The maximum allowable increase above naturally occurring turbidity is 5 nephelometric turbidity units except as permitted in ARM 17.30.637.

- Temperature variations are specifically limited, depending upon the temperature range of the receiving water.

- No increases are allowed above naturally occurring concentrations of sediment, settable solids, oils, or floating solids, which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife.

- True color must not be increased more than five units above naturally occurring color.

- Concentrations of carcinogenic, bioconcentrating, toxic or harmful parameters which would remain in the water after conventional water treatment may not exceed the applicable standards set forth in department Circular WQB-7.

Additional restrictions on any discharge to surface waters are included in:

ARM 17.30.635 (Applicable) requires that industrial waste must receive, as a minimum, treatment equivalent to the best practicable control technology currently available (BPCTCA) as defined in 40 CFR Subchapter N and subsequent amendments. Industrial waste is defined as any waste substance from the process of business or industry or from the development of any natural resource, together with any sewage that may be present, Section 75-5-103, MCA. This section also requires that in designing a disposal system, stream flow dilution requirements must be based on the minimum consecutive 7-day average flow which may be expected to occur on the average of once in 10 years.

ARM 17.30.637 (Applicable), which prohibits discharges containing substances that will:

(a) settle to form objectionable sludge deposits or emulsions beneath the water's surface or upon adjoining shorelines;

(b) create floating debris, scum, a visible oil film (or be present in concentrations at or in excess of 10 milligrams per liter) or globules of grease or other floating materials;

(c) produce odors, colors or other conditions which create a nuisance or render undesirable tastes to fish flesh or make fish inedible;

(d) create concentrations or combinations of materials which are toxic or harmful to human, animal, plant or aquatic life; and

(e) create conditions which produce undesirable aquatic life.

ARM 17.30.637 also provides that leaching pads, tailing ponds, or water, waste, or product holding facilities must be located, constructed, operated, and maintained to prevent any discharge, seepage, drainage, infiltration, or flow which may result in pollution of state waters, and a monitoring system may be required to ensure such compliance. No pollutants may be discharged and no activities may be conducted which, either alone or in combination with other wastes or activities, result in the total dissolved gas pressure relative to the water surface exceeding 110 percent of saturation.

In determining ARARs, one should check the "prohibitions" set out in 17.30.637 for any site specific prohibitions.

ARM 17.30.501-518 provides that discharges to surface water or groundwater may be granted a mixing zone on a case by case basis by the DEQ in accordance with its written implementation policy and restrictions.

ARM 17.30.1345 (Applicable), adopts and incorporates the provisions of 40 CFR Part 125.3 for criteria and standards of the imposition of technology-based treatment requirements in MPDES permits. Although the permit requirement would not apply to on-site discharges, the substantive requirements of Part 125.3 are applicable (i.e., for toxic and non-conventional pollutants). Treatment must apply the best available technology (BAT) economically achievable and, for conventional pollutants, application of the best conventional pollutant control technology (BCT) is required. Where effluent limitations are not specified for the particular industry or industrial category at issue, BCT/BAT technology-based treatment requirements are determined on a case-by-case basis using best professional judgment (BPJ). <u>See</u> CERCLA Compliance with Other Laws Manual, Vol. I, August 1988, p.3-4 and 3-7.

The Water Quality Act and regulations also include non-degradation provisions which require that waters which are of higher quality than the applicable classification be maintained at that high quality, and discharges which would degrade that water are prohibited. Montana's standard for non-degradation of water quality is applicable for all constituents for which pertinent portions of the Dog Creek drainage are of higher quality than the B-1 classification. If any remedial action constitutes a new source of pollution or an increased source of pollution, the non-degradation standard requires the degree of waste treatment necessary to maintain the existing water quality of constituents that are of higher quality than the applicable classification.

ARM 17.30.702 and 705 (Applicable) defines "degradation" and applies non-degradation requirements to any activity of man which would cause a new or increased source of pollution to state waters.

ARM 17.30.706-708 (Applicable) establishes the informational requirements for nondegradation significance/authorization review and department procedures for nondegradation review and decisions.

ARM 17.30.715-717 (Applicable) establishes criteria for determining nonsignificant changes in water quality, categories of activities that cause nonsignificant changes in water quality, and the requirement for implementation of water quality protection practices.

The MPDES permit requirements are technically not applicable to remedial actions at CERCLA sites because ARM 17.30.1310(3) exempts "Any discharge in compliance with the instructions of an on-scene coordinator pursuant to 40 CFR Part 300 <u>et</u> <u>seq</u>. (the NCP)." This exemption is even broader than the 121(e) permit exemption, because it would apply even to an off-site discharge, if such discharge were "in compliance with the instructions of the OSC." The MPDES requirements could still be relevant and appropriate to discharges of pollutants as part of a remedial action. However, it would be probably be more appropriate to identify the federal requirements as the relevant and appropriate requirements because of the express state exemption, which arguably represents a determination that the state MPDES requirements are not relevant or appropriate. Note that this analysis does not apply to a site being addressed only under CECRA and not CERCLA, because the exemption applies only to the instructions of an OSC under the NCP.

The MPDES standards (the substantive requirements to be enforced through the permitting process) are set out in 17.30.1203-1209. These standards are all simply incorporations of the federal regulations.

3.1.2 Montana Water Use Act

Montana Groundwater Pollution Control System (Applicable)

ARM 17.30.1006 (Applicable) classifies groundwater into Classes I through IV based on the present and future most beneficial uses of the groundwater, and establishes groundwater quality standards applicable with respect to each groundwater classification. Groundwater classifications are based on natural specific conductance (ARM 17.30.1005). Class I is the highest quality class; class IV the lowest. ARM 17.30.1006 provides that Class I groundwaters have a specific conductance (SC) of less than or equal to 1,000 microSiemens/cm at 25° C. The SC of groundwater at the Bald Butte Millsite is unknown for there are no ground water wells available for monitoring specific conductance. One flowing adit at the Devon/Sterling and Albion Mines site has a specific conductance of 390 microSiemens/cm and thus would qualify as a Class I groundwater.

ARM 17.30.1005(2) and (3) (Applicable) provides that it is not necessary to treat discharges to a purer condition than the natural condition of the receiving water, within the meaning of 75-5-306, MCA. Further, groundwater standards may be exceeded within a mixing zone established pursuant to ARM 27.30.501 through 17.30.518.

ARM 17.30.1011 (Applicable) prohibits degradation and states any ground water whose existing quality is higher than the established groundwater quality standards for its classification must be maintained at that high quality in accordance with 75-5-303, MCA and ARM Title 17, chapter 30, subchapter 7.

3.1.3 Public Water Supplies Act

EPA has granted the State of Montana primacy in enforcement of the Safe Drinking Water Act. The state regulations under the state Public Water Supply Act, §§ 75-6-101 et seq., MCA, substantially parallel the federal law and are relevant and appropriate.

Public Water Supply Regulations (Relevant and Appropriate)

Note that ARM 17.38.203-207 specifies MCLs for inorganic, organic, turbidity, radiological, and microbiological parameters.

ARM 17.38.205 (Relevant and Appropriate) establishes the following maximum turbidity contaminant level for public water supply systems which use surface water in whole or in part:

1. One turbidity unit ("TU"), as determined by a monthly average, except that a level not exceeding 5 TU may be allowed if the supplier of water can demonstrate to the department that the higher turbidity does not:

   (a) interfere with disinfection;

(b) prevent maintenance of an effective disinfectant agent throughout the distribution system; or

(c) interfere with microbiological determination.

2. 5 TU based on an average for two consecutive days.

Although no groundwater is being used at the site for drinking water, one domestic water well is located within 2 miles southeast of the Bald Butte Millsite, therefore, this ARAR is relevant and appropriate.

3.1.4 Clean Air Act (Relevant and Appropriate and Applicable)

Air quality regulations pursuant to the Act, §§ 75-2-101 et seq., MCA, are discussed below.

ARM 17.8.222 (Applicable) specifies that no person shall cause or contribute to concentrations of lead in the ambient air which exceed the following: 90-day average -- 1.5 micrograms per cubic meter of air, 90-day average, not to be exceeded.

ARM 17.8.220 (Applicable) specifies that no person shall cause or contribute to concentrations of particulate matter in the ambient air such that the mass of settled particulate matter exceeds the following 30-day average: 10 grams per square meter, 30-day average, not to be exceeded.

ARM 17.8.223 (Applicable) specifies that no person may cause or contribute to concentrations of PM-10 in the ambient air which exceed the following standard:

1. 24-hour average: 150 micrograms per cubic meter of air, 24-hour average, with not more that one expected exceedance per calendar year.

2. Annual average: 50 micrograms per cubic meter of air, expected annual average, not to be exceeded.

ARM 17.8.304 (2) (Applicable) states that "no person may cause or authorize emissions to be discharged in the outdoor atmosphere from any source installed after November 23, 1968, that exhibit an opacity of 20% or greater averaged over six consecutive minutes."

ARM 17.8.308 (Applicable) states that no person shall cause or authorize the production, handling, transportation, or storage of any material unless reasonable precautions are taken to control emissions of airborne particulate matter.

ARM 17.8.341 (Applicable) adopts the standards of 40 CFR Part 61 setting forth emission standards for hazardous air pollutants.

ARM 17.24.761 (Applicable) requires a fugitive dust control program be implemented in reclamation operations and lists specific but non-exclusive measures as necessary components of such a program.

3.1.5 Occupational Health Act

Occupational health regulations pursuant to the Occupational Health Act (see § 50-70-113, MCA) are discussed below.

Occupational Health Regulations (Applicable)

The occupational safety and health laws are applicable protections for employees working at CERCLA sites. See NCP, 40 CFR § 300.150. The occupational health laws identified below prescribe certain limits of exposure considered necessary to protect the health of those with sustained exposure to specified substances. The nature of this removal action may subject persons other than employees to exposures sustained throughout the work period. These limits must be considered relevant and appropriate for those living or present in the areas affected by the removal action.

ARM 17.74.102 (Applicable) establishes maximum threshold limit values for air contaminants under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse health effects. In accordance with this rule, no worker (or other person in or near the work site) shall be exposed to air contaminant levels in excess of the threshold limit values listed in each of the tables below. Compliance with the rule is determined by calculating the person's exposure to air contaminants as individual substances or as the exposure to a mixture of substances in accordance with formulas established by this rule. A person's exposure to any contaminant in the following table shall at no time exceed the threshold limit value listed:

Air Contaminant	Concentration (mg/m^3)
Arsenic and compounds (as As)	0.01
Cadmium	0.005
Chromium	0.5
Cobalt	0.1
Copper dust and mist	1.0
Cyanide	5.0
Lead	0.05
Manganese	5.0
Mercury	0.1
Molybdenum	
Soluble compounds	5.0
Insoluble compounds	15.0
Silver, Metal and soluble compounds	0.01
Zinc	5.0

ARM 17.74.101 (Applicable) establishes occupational noise levels and provides that no worker shall be exposed to noise levels in excess of specified levels.

3.2 MONTANA LOCATION-SPECIFIC ARARS

3.2.1 Floodplain and Floodway Management Act

Section 76-5-401, MCA, (Applicable) specifies the types of uses permissible in a designated 100-year floodway or floodplain and generally prohibits permanent structures, fill or permanent storage of materials or equipment.

Section 76-5-402, MCA, (Applicable) specifies uses allowed in the floodplain, excluding the floodway, and allows structures meeting certain minimum standards.

Section 76-5-403, MCA, (Applicable) lists certain uses which are prohibited in a designated floodway, including:

- any building for living purposes or place of assembly or permanent use by human beings;
- any structure or excavation that will cause water to be diverted from the established floodway, cause erosion, obstruct the natural flow of water, or reduce the carrying capacity of the floodway; or
- the construction or permanent storage of an object subject to flotation or movement during flood level periods.

<u>Floodplain Management Regulations</u>

ARM 36.15.216 (Applicable - substantive provisions only) specifies factors to consider in determining whether a permit should be issued to establish or alter an artificial obstruction or nonconforming use in the floodplain or floodway. While permit requirements are not directly applicable to activities conducted entirely on site, the criteria used to determine whether to approve establishment or alteration of an artificial obstruction or nonconforming use should be applied by the decision-makers in evaluating proposed remedial alternatives which involve artificial obstructions or nonconforming uses in the floodway or floodplain. Thus the following criteria are relevant and appropriate considerations in evaluating any such obstructions or uses:

- the danger to life and property from backwater or diverted flow caused by the obstruction;
- the danger that the obstruction will be swept downstream to the injury of others;
- the availability of alternative locations;
- the construction or alteration of the obstruction in such a manner as to lessen the danger;
- the permanence of the obstruction; and
- the anticipated development in the foreseeable future of the area which may be affected by the obstruction.

ARM 36.15.601 (Applicable - substantive provisions only) specifies open space uses which shall be allowed without a permit anywhere in the designated floodway provided that they are not prohibited by any other ordinance or statute and provided that they do not require structures other than portable structures, fill or permanent storage of materials or equipment.

ARM 36.15.602 (Applicable - substantive provisions only) specifies conditions for allowing certain artificial obstructions in a designated floodway, including conditions for excavation of material from pits or pools within the floodway.

ARM 36.15.603 (Applicable - substantive provisions only) provides that proposed diversions or changes in place of diversion must be evaluated by the Montana Department of Natural Resources and Conservation (MDNRC) to determine whether they may significantly affect flood flows and, therefore, require a permit. While permit requirements are not applicable for remedial actions conducted entirely on site, the following criteria used to determine when a permit shall not be granted are relevant and appropriate:

- The proposed diversion will increase the upstream elevation of the 100-year flood a significant amount (one-half foot or as otherwise determined by the permit issuing authority).

- The proposed diversion is not designed and constructed to minimize potential erosion from a flood of 100-year frequency.

- Any permanent diversion structure crossing the full width of the stream channel is not designed and constructed to safely withstand up to a flood of 100-year frequency.

ARM 36.15.604 (Applicable - substantive provisions only) precludes new construction or alteration of an artificial obstruction that will significantly increase the upstream elevation of the flood of 100-year frequency (0.5 feet or as otherwise determined by the permit issuing authority) or significantly increase flood velocities.

ARM 36.16.605(1) and (2) (Applicable - substantive provisions only) enumerate artificial obstructions and non-conforming uses that are prohibited within the designated floodway except as allowed by permit and includes "a structure or excavation that will cause water to be diverted from the established floodway, cause erosion, obstruct the natural flow of water, or reduce the carrying capacity of the floodway...". Solid and hazardous waste disposal and storage of toxic, flammable, hazardous, or explosive materials are also prohibited.

ARM 36.15.606 (Applicable - substantive provisions only) enumerates flood control works that are allowed within designated floodways pursuant to permit. Although the permit requirements are not applicable for activities conducted entirely on site, the following conditions are relevant and appropriate:

- Flood control levies and flood walls are allowed if they are designed and constructed to safely convey a flood of 100-year frequency, and their cumulative effect combined with allowable flood fringe encroachments does not increase the unobstructed elevation of a flood of 100-year frequency more than one-half foot at any point.

- Riprap, if not hand placed, is allowed if it is designed to withstand a flood of 100-year frequency; does not increase the elevation of the 100-year frequency flood; and will not increase erosion upstream, downstream, or across stream from the riprap site.

- Channelization projects are allowed if they do not significantly increase the magnitude, velocity, or elevation of the flood of 100-year frequency downstream from such projects.

- Dams are allowed if they are designed and constructed in accordance with approved safety standards and they will not increase flood hazards downstream either through operational procedures or improper hydrologic design.

ARM 36.15.701 (Applicable) requires that, within the flood fringe area, public or private structures and facilities for liquid or solid waste treatment and disposal must be flood-proofed to ensure that no pollutants enter flood waters.

ARM 36.15.703 (Applicable) is applicable in flood fringe areas (i.e., areas in the floodplain but outside of the designated floodway) of the site and prohibits, with limited exceptions, solid and hazardous waste disposal and storage of toxic, flammable, hazardous, or explosive materials.

ARM 36.15.801 (Applicable) states that wildlife management and natural areas are permitted and encouraged uses within a floodplain.

The Bald Butte Millsite and the Devon/Sterling and Albion Mines are not located in a designated 100-year floodplain.

3.2.2 Natural Streambed and Land Preservation Act

Natural Streambed and Land Preservation Standards

Reclamation activities proposed for the Bald Butte Millsite and the Devon/Sterling and Albion Mines will alter or affect a perennial stream. Although Dog Creek is probably not considered a designated fishing water, trout were reported in the largest pond on site during the preliminary assessment site investigation and were observed during the site characterization work. Section 87-5-501, MCA, (Applicable) declares that the fish and wildlife resources of the State of Montana, particularly the fishing waters, are to be protected and preserved to the end that they be available for all time, without change, in their natural existing state except as may be necessary and appropriate after due consideration of all factors involved.

Sections 87-5-502 and 504, MCA, (Applicable - substantive provisions only) provide that a state agency or subdivision shall not construct, modify, operate, maintain or fail to maintain any construction project or hydraulic project which may or will obstruct, damage, diminish, destroy, change, modify, or vary the natural existing shape and form of any stream or its banks or tributaries in a manner that will adversely affect any fish or game habitat. This requirement is relevant and appropriate for entities carrying out remedial actions approved by the state.

ARM 36.2.410 (Applicable) defines project information which applicant must provide to the conservation district and provides that stream must be designed and constructed to minimize adverse impacts to stream, future disturbances to the stream and erosion; temporary structures used during construction must handle reasonably anticipated high flows; channel alteration must be designed to retain original stream length or otherwise provide for hydrologic stability; streambank vegetation must be protected except where removal is necessary and riprap, rock, or other material must be sized adequately to protect streambank erosion.

3.2.3 Antiquities Act

Section 22-3-424, MCA, (Relevant and Appropriate) requires that the identification and protection of heritage properties and paleontological remains on lands owned by the state are given appropriate consideration in state agency decision-making. Property in the vicinity of the Bald Butte Millsite and the Devon/Sterling and Albion Mines is primarily private lands consisting of patented mining claims. The Antiquities Act is applicable only to state lands, but is relevant and appropriate in decision-making affecting other properties. Heritage property is defined in § 22-3-421, MCA, as any district, site, building, structure, or object located upon or beneath the earth or under water that is significant in American history, architecture, archaeology, or culture.

Section 22-3-433, MCA, (Relevant and Appropriate) requires that evaluation of environmental impacts include consultation with the historic preservation officer concerning the identification and location of heritage properties and paleontological remains on lands that may be adversely impacted by the proposed action. The responsible party, in consultation with the historic preservation officer and the preservation review board, shall include a plan for the avoidance or mitigation of damage to heritage properties and paleontological remains to the greatest extent practicable. (Applicable only to state lands, but is relevant and appropriate in decision-making affecting other properties).

Section 22-3-435, MCA, (Relevant and Appropriate) requires any person conducting activities, including survey, excavation or construction, who discovers any heritage property or paleontological remains or who finds that an operation may damage heritage properties or paleontological remains shall promptly report to the historic preservation officer the discovery of such findings and shall take all reasonable steps to ensure preservation of the heritage property or paleontological remains. (Applicable only to state lands, but is relevant and appropriate in decision-making affecting other properties).

<u>Cultural Resources Regulations</u>

ARM 12.8.501 through 12.8.508 (Relevant and Appropriate) prescribe specific procedures to be followed to ensure adequate consideration of cultural values in agency decision-making.

3.3 MONTANA ACTION-SPECIFIC ARARS

3.3.1 Water Quality Act (Applicable)

Section 75-5-605, MCA, makes it unlawful to cause pollution of any state waters or to place or cause to be placed any wastes in a location where they are likely to cause pollution of any State waters.

<u>Surface Water Quality Standards (Applicable)</u>

ARM 17.30.610 (1) (Applicable) provides that specified waters in the Clark Fork River drainage, including the Dog Creek drainage, are classified B-1 for water use.

The standards for B-1 classification waters are contained in ARM 17.30.623 (Applicable) of the Montana Water Quality regulations. These standards place limits on fecal coliform content, dissolved oxygen concentration, pH balance, turbidity, water temperature, sediments, solids, oils and color. Concentrations of toxic or deleterious substances which would remain in the water after conventional treatment cannot exceed applicable standards set forth in department Circular WQB-7.

Additional restrictions on any discharge to surface waters are included in:

ARM 17.30.635 (Applicable), which requires that industrial waste must receive, as a minimum, treatment equivalent to the best practicable control technology currently available (BPCTCA) as defined in 40 CFR Subchapter N and subsequent amendments. Industrial waste is defined in Section 75-5-103, MCA as any waste substance from the process of business or industry or from the development of any natural resource, together with any sewage that may be present. ARM 17.30.635 also requires that in designing a disposal system, stream flow dilution requirements must be based on the minimum consecutive 7-day average flow which may be expected to occur on the average of once in 10 years.

ARM 17.30.637 (Applicable), which prohibits discharges containing substances that will:

(a) settle to form objectionable sludge deposits or emulsions beneath the water's surface or upon adjoining shorelines;

(b) create floating debris, scum, a visible oil film (or be present in concentrations at or in excess of 10 milligrams per liter) or globules of grease or other floating materials;

(c) produce odors, colors or other conditions which create a nuisance or render undesirable tastes to fish flesh or make fish inedible;

(d) create concentrations or combinations of materials which are toxic or harmful to human, animal, plant or aquatic life; or

(e) create conditions which produce undesirable aquatic life.

ARM 17.30.637(4) and (10) also provide that leaching pads, tailing ponds, water, waste, or product holding facilities must be located, constructed, operated, and maintained to prevent any discharge, seepage, drainage, infiltration, or flow which may result in pollution of state waters. A monitoring system may be required to ensure such compliance. No pollutants may be discharged and no activities may be conducted which, either alone or in combination with other wastes or activities, result in the total dissolved gas pressure relative to the water surface exceeding 110 percent of saturation. The rule also sets out other general prohibitions one should review for any site specific conditions.

ARM 17.30.505-508 provides that discharges to surface waters and groundwaters may be granted a mixing zone on a case by case basis by the DEQ in accordance with its written implementation policy. In granting a mixing zone, the department shall ensure (1) surface water and ground water quality human health and aquatic life standards must not be exceeded beyond the mixing zone; (2) discharges to wetlands (other than constructed wetlands) will not be granted a mixing zone for parameters for which the state has adopted numeric acute or chronic standards for aquatic life or for human health in the surface water quality standards unless (a) the standards will not be exceeded beyond the boundaries of the mixing zone, (b) existing beneficial uses will not be threatened or harmed; and (c) the conditions in 75-5-303(3), MCA are met; (3) for discharges to surface water that first pass through the ground, such discharges from infiltration systems or land application areas, the surface water mixing zone begins at the most upstream point of discharge into the receiving surface water. If the discharge continues to occur downstream beyond a distance equal to 10 times the stream width measured at the upstream discharge point at low flow, a standard mixing zone will not be granted and (4) no mixing zone for groundwater will be allowed if the zone of influence of an existing drinking water supply well will intercept the mixing zone.

ARM 17.30.1203 (Applicable), which adopts and incorporates the provisions of 40 CFR Part 125 for criteria and standards for the imposition of technology-based treatment requirements in MPDES permits. Although the permit requirement would not apply to on-site discharges, the substantive requirements of Part 125 are applicable, i.e., for toxic and nonconventional pollutants treatment must apply the best available technology (BAT) economically achievable; for conventional pollutants, application of the best conventional pollutant control technology (BCT) is required. Where effluent limitations are not specified for the particular industry or industrial category at issue, BAT/BCT technology-based treatment requirements are determined on a case by case basis using best professional judgment (BPJ). See CERCLA Compliance with Other Laws Manual, Vol. I, August 1988, p. 3-4 and 3-7.

The Water Quality Act and regulations also include nondegradation provisions (17.30.701 et seq.) which require that waters which are of higher quality than the applicable classification be maintained at that high quality, and discharges which would degrade that water are prohibited. Montana's standard for nondegradation of water quality is applicable for all constituents for which pertinent portions of the Dog Creek are of higher quality than the B-1 classification. If any remedial action constitutes a new source of pollution or an increased source of pollution, the nondegradation standard requires the degree of waste treatment necessary to maintain the existing water quality for constituents that are of higher quality than the applicable classification. Categories of activities that cause non-significant changes in water quality are described in ARM 17.30.716. Informational requirements for non-degradation significance/authorization review, department procedures, and criteria for determining non-significant changes in water quality are presented in ARM 17.30.706-715.

The MPDES permit requirements are technically not applicable to remedial actions at CERCLA sites because ARM 16.20.1305(3) exempts "Any discharge in compliance with the instructions of an on-scene coordinator pursuant to 40 CFR Part 300 et seq. (the NCP)." This exemption is even broader than the 121(e) permit exemption, because it would apply even to an off-site discharge, if such discharge were "in compliance with the instructions of the OSC." The MPDES requirements could still be relevant and appropriate to discharges of pollutants as part of a remedial action. However, it would probably be more appropriate to identify the federal requirements as the relevant and appropriate requirements because of the express state exemption, which arguably represents a determination that the state MPDES requirements are not relevant or appropriate. Note that this analysis does not apply to a site being addressed only under CECRA and not CERCLA, because the exemption applies only to the instructions of an OSC under the NCP.

The MPDES standards (the substantive requirements to be enforced through the permitting process) are set out in 17.30.1203, et seq. These standards are all simply incorporation of the federal regulations, some of which are included as ARARs, for example:

> ARM 17.30.1206 (Relevant and Appropriate) adopts and incorporates language for toxic pollutant effluent standards found in 40 CFR Part 129.

ARM 17.30.1207 (Relevant and Appropriate) adopts and incorporates language for effluent limitations and standards of performance found in 40 CFR Subchapter N (Parts 401-471, except Part 403).

ARM 17.30.1208 (Relevant and Appropriate) adopts and incorporates language for hazardous substances found in 40 CFR Part 116.

ARM 17.30.1209 (Relevant and Appropriate) adopts and incorporates language for minimum treatment requirements for secondary treatment or the equivalent for publicly owned treatment works (POTW's) and for certain industrial categories found in 40 CFR Part 133.

3.3.2 Montana Groundwater Act

Montana Groundwater Pollution Control System (Applicable)

ARM 17.30.1006 (Applicable) classifies groundwater into Classes I through IV based on the present and future most beneficial uses of the groundwater and establishes groundwater classification standards. Groundwater is classified based on the natural specific conductance of the water (ARM 17.30.1005). Class I is the highest quality class; class IV the lowest. ARM 17.30.1006 provides that Class I groundwaters have a specific conductance (SC) of less than 1,000 microSiemens/cm at 25° C. The SC of groundwater at the Bald Butte Millsite is unknown for there are no ground water wells available for monitoring specific conductance. One flowing adit at the Devon/Sterling and Albion Mines site has a specific conductance of 390 microSiemens/cm and thus would qualify as a Class I groundwater.

ARM 17.30.1011 (Applicable) provides that any groundwater whose existing quality is higher than the standard for its classification must be maintained at that high quality in accordance with 75-5-303, MCA and ARM Title 17, Chapter 30, Subchapter 7.

3.3.3 Clean Air Act

Air Quality Regulations (Applicable)

Dust suppression and similar actions may be necessary to control the release of substances into the air as a result of earth moving and transportation of mine/mill wastes both off- and on-site. The ambient air standards for specific contaminants and for particulates are set forth in the federal contaminant-specific section above. The levels of certain substances that may not be exceeded are identified in the Air Quality section of the contaminant-specific State ARARs. Additional air quality regulations under the state Clean Air Act, §§ 75-2-101 et seq., MCA, are discussed below.

ARM 17.8.221 (Applicable) specifies that no person shall cause or contribute to concentrations of lead in the ambient air which exceed the following: 90-day average--1.5 micrograms per cubic meter of air, 90-day average, not to be exceeded.

ARM 17.8.604 (Applicable) lists certain wastes that may not be disposed of by open burning, including oil or petroleum products, RCRA hazardous wastes, chemicals, and treated lumber and timbers. Any waste which is moved from the premises where it was generated and any trade waste (material resulting from construction or operation of any business, trade, industry or demolition project) may be open burned only in accordance with the substantive requirements of 17.8.611 or 612. Open burning means combustion of any material directly in the open air without a receptacle, or in a receptacle other than a furnace, multiple chambered incinerator or wood waste burner, ARM 17.8.601(7).

ARM 17.8.308 (Applicable) states that no person shall cause or authorize the production, handling, transportation or storage of any material unless reasonable precautions are taken to control emissions of airborne particulate matter.

ARM 17.8.304 (Applicable) states that "no person may cause or authorize emissions to be discharged in the outdoor atmosphere...that exhibit an opacity of twenty percent (20 percent) or greater averaged over six consecutive minutes."

ARM 17.8.324 (Applicable) prohibits storage tanks for any crude oil, gasoline, or certain petroleum distillates of more than 65,000 gallons capacity unless it conforms to the requirements of this section.

3.3.4 Solid Waste Management Act

Several regulations promulgated under the Solid Waste Management Act, §§ 75-10-201 <u>et</u> <u>seq</u>., MCA, and the Hazardous Waste Management Act, §§ 75-10-401 <u>et</u> <u>seq</u>., MCA, are discussed in the federal section of ARARs, because they implement those federal programs in the State. The Solid Waste Management Act was significantly revised in the 1995 Montana Legislature.

<u>Solid Waste Management Regulations</u>

ARM 17.50.504 (Applicable) restricts the types of wastes that disposal sites may handle.

ARM 17.50.505 (Applicable) sets forth standards that all solid waste disposal sites must meet.

ARM 17.50.508 (Relevant and Appropriate) is the provision that establishes the solid waste management system license application. Although a license would not be required for remedial activity conducted entirely on site, the information required by this section is relevant and appropriate.

ARM 17.50.509 (Applicable) sets forth that every proposed solid waste management system must be evaluated, taking into consideration the physical characteristics of the disposal site, the types and amount of waste, the operation and maintenance plan for the system, and the plan for reclamation and the land's ultimate use.

ARM 17.50.510 and 17.50.511 (Applicable) set forth the general and specific operation and maintenance requirements for solid waste management systems.

ARM 17.50.523 (Applicable) specifies that solid waste must be transported in such a manner as to prevent its discharge, dumping, spilling, or leaking from the transport vehicle.

3.3.5 Hazardous Waste Management Act (Relevant and Appropriate)

ARMs 17.54.111, 17.54.112 and 17.54.119 (Relevant and Appropriate) establish permit conditions, including monitoring, record keeping requirements, operation and maintenance requirements, sampling and monitoring requirements, and the option for DEQ to establish additional permit conditions on a case-by-case basis.

ARMs 17.54.130 and 17.54.131 (Relevant and Appropriate) state the required contents of a Hazardous Waste Management (HWM) permit application. The information and substantive requirements of these provisions are relevant and appropriate.

ARM 17.54.351 (Relevant and Appropriate) gives hazardous waste sampling protocols, testing methods, and analytical procedures.

ARM 17.54.401 through 17.54.418 and 17.54.501 through 17.54.527 (Relevant and Appropriate) set forth the standards and requirements for generators and transporters of hazardous waste.

ARMs 17.54.701 through 17.54.705 (Relevant and Appropriate) establish hazardous waste management facility standards and requirements.

ARMs 17.54.801 through 17.54.833 (Relevant and Appropriate) set the financial assurance requirements for closure of hazardous waste management facilities.

3.3.6 Strip and Underground Mine Reclamation Act

The Bald Butte Millsite and Devon/Sterling and Albion Mines are abandoned hardrock mine/mill sites. Regulations promulgated under Montana's Strip and Underground Mine Reclamation Act §§ 82-4-201 et seq., MCA, provide detailed guidelines for addressing the impacts of mine reclamation activities and earth moving projects and may be relevant and appropriate for addressing these impacts in DEQ-MWCB reclamation projects.

The hydrology regulations promulgated under the Strip and Underground Mine Reclamation Act, §§ 82-4-201 et seq., MCA, provide detailed guidelines for addressing the hydrologic impacts of mine reclamation activities and earth moving projects and may be relevant and appropriate for addressing these impacts in Mine Waste Cleanup Bureau (MWCB) reclamation projects.

ARM 17.24.631 (Relevant and Appropriate) provides that long-term adverse changes in the hydrologic balance from mining and reclamation activities, such as changes in water quality and quantity, depth to groundwater, and location of surface water drainage channels shall be minimized. Water pollution must be minimized and, where necessary, treatment methods utilized. Diversions of drainages to avoid contamination must be used in preference to the use of water treatment facilities. Other pollution minimization devices must be used if appropriate, including stabilizing disturbed areas through land shaping, diverting run-off, planting quickly germinating and growing stands of temporary vegetation, regulating channel velocity of water, lining drainage channels with rock or vegetation, mulching, and control of acid-forming, and toxic-forming waste materials.

ARM 17.24.633 (Relevant and Appropriate) states that all surface drainage from a disturbed area must be treated by the best technology currently available (BTCA). Treatment must continue until the area is stabilized.

ARM 17.24.634 (Relevant and Appropriate) provides that drainage design shall emphasize channel and floodplain pre-mining configuration that blends with the undisturbed drainage above and below and provides specific requirements for designing the reclaimed drainage to:

- meander naturally;
- remain in dynamic equilibrium with the system;
- improve unstable pre-mining conditions;
- provide for floods; and
- establish a pre-mining diversity of aquatic habitats and riparian vegetation.

ARM 17.24.635 through 17.24.637 (Relevant and Appropriate) set forth requirements for temporary and permanent diversions.

ARM 17.24.640 (Relevant and Appropriate) provides that discharge from sedimentation ponds, permanent and temporary impoundments, and diversions shall be controlled by energy dissipaters, riprap channels, and other devices, where necessary, to reduce erosion, prevent deepening or enlargement of stream channels, and to minimize disturbance of the hydrologic balance.

Section 82-4-231, MCA, (Relevant and Appropriate) sets forth that as rapidly, completely and effectively as the most modern technology and the most advanced state of the art will allow, each operator shall reclaim and revegetate the land affected by his operation. The operator must grade, backfill, topsoil, reduce highwalls, stabilize subsidence, and control water. In so doing all measures must be taken to eliminate damage from soil erosion, subsidence, land slides, water pollution, and hazards dangerous to life and property.

In addition, this section directs the operator to employ various specific reclamation measures such as:

- burying under adequate fill all toxic materials, shale, minerals, or any other material determined by DEQ to be acid producing, toxic, undesirable, or creating a hazard;
- impounding, draining, or treating all run-off waters so as to reduce soil erosion, damage to grazing and agricultural lands, and pollution of surface and subsurface waters;
- stockpiling and protecting all mining and processing wastes from erosion until these wastes can be disposed of according to the provisions of this part;
- minimizing disturbances and adverse impacts of the operation on fish, wildlife, and related environmental values;
- minimizing disturbances to surface and groundwater systems by avoiding acid or other toxic mine drainage by such measures as, but not limited to, preventing or removing water from

contact with toxic-producing deposits and treating drainage to reduce toxic content which adversely affects downstream water upon being released to water courses; and

- stabilizing and protecting all surface areas, including spoil piles to effectively control air pollution.

Section 82-4-233, MCA, (Relevant and Appropriate) provides that after grading, the operator must plant vegetation that will yield a diverse, effective, and permanent vegetative cover of the same seasonal variety native to the area and capable of self-regeneration. The vegetative cover must be capable of:

- feeding and withstanding grazing pressure from a quantity and mixture of wildlife and livestock;
- regenerating under the natural conditions prevalent at the site; and
- preventing soil erosion to the extent achieved before the operation.

ARM 17.24.501 (Relevant and Appropriate) gives general backfilling and final grading requirements.

ARM 17.24.519 (Relevant and Appropriate) provides that an operator may be required to monitor settling of regraded areas.

ARM 17.24.638 (Relevant and Appropriate) specifies sediment control measures to be implemented during operations.

ARM 17.24.641 (Relevant and Appropriate) sets forth methods for prevention of drainage from acid- and toxic-forming spoils into ground and surface waters.

ARM 17.24.642 (Relevant and Appropriate) prohibits permanent impoundments with certain exceptions and sets standards for temporary and permanent impoundments.

ARM 17.24.643 through 17.24.646 (Relevant and Appropriate) provide for groundwater protection, groundwater recharge protection, and surface and groundwater monitoring.

ARM 17.24.649 (Relevant and Appropriate) prohibits the discharge, diversion, or infiltration of surface and groundwater into existing underground mine workings.

ARM 17.24.701 and 17.24.702 (Relevant and Appropriate) require that during the removal, redistributing, and stockpiling of soil (for reclamation):

- The operator shall limit the area from which soil is removed at any one time to minimize wind and water erosion, and the operator shall take other measures, as necessary, to control erosion.
- Regraded areas must be deep-tilled, subsoiled, or otherwise treated to eliminate any possible slippage potential, to relieve compaction, and to promote root penetration and permeability of the underlying layer. This preparation must be done on the contour whenever possible and to a minimum depth of 12 inches.

- The operator shall, during and after redistribution, prevent, to the extent possible, spoil and soil compaction; protect against soil erosion, contamination, and degradation; and minimize the deterioration of biological properties of the soil.

- Redistribution must be done in a manner that achieves approximate uniform thickness consistent with soil resource availability and appropriate for the post-mining vegetation, land uses, contours, and surface water drainage systems.

- Redistributed soil must be reconditioned by subsoiling or other appropriate methods.

ARM 17.24.703 (Relevant and Appropriate) requires that when using materials other than, or along with, soil for final surfacing in reclamation, the operator must demonstrate that the material: 1) is at least as capable as the soil of supporting the approved vegetation and subsequent land use; and 2) the medium must be the best available in the area to support vegetation. Such substitutes must be used in a manner consistent with the requirements for redistribution of soil in ARM 17.24.701 and 702.

ARM 17.2.711 (Relevant and Appropriate) requires that a diverse, effective, and permanent vegetative cover of the same seasonal variety native to the area of land to be affected shall be established except on road surfaces and below the low-water line of permanent impoundments. Vegetative cover is considered of the same seasonal variety if it consists of a mixture of species of equal or superior utility when compared with the natural (or pre-existing) vegetation during each season of the year.

ARM 17.24.713 (Relevant and Appropriate) provides that seeding and planting of disturbed areas must be conducted during the first appropriate period for favorable planting after final seedbed preparation but may not be more than 90 days after soil has been replaced.

ARM 17.24.714 (Relevant and Appropriate) requires use of mulch or cover crop or both until an adequate permanent cover can be established. Use of mulching and temporary cover may be suspended under certain conditions.

ARM 17.24.716 (Relevant and Appropriate) establishes the required method of revegetation and provides that introduced species may be substituted for native species as part of an approved plan.

ARM 17.24.717 (Relevant and Appropriate) give requirements for tree planting if necessary to comply with MCA 82-4-233.

ARM 17.24.718 (Relevant and Appropriate) requires the use of soil amendments and other means such as irrigation, management, fencing, or other measures if necessary to establish a diverse and permanent vegetative cover.

ARM 17.24.719 (Relevant and Appropriate) prohibits livestock grazing on reclaimed land until the seedlings are established and can sustain managed grazing.

ARM 17.24.721 (Relevant and Appropriate) specifies that rills or gullies deeper than nine inches must be stabilized. In some instances, more shallow rills and gullies must be stabilized.

ARM 17.24.723 (Relevant and Appropriate) provides that the operator shall conduct approved periodic monitoring of vegetation, soils and wildlife.

ARM 17.24.724 (Relevant and Appropriate) provides that revegetation success must be measured by approved, unmined, reference areas. There shall be at least one reference area for each plant community type. Required management for these reference areas is set forth.

ARM 17.24.726 (Relevant and Appropriate) sets forth the required methods for measuring productivity of revegetated areas.

ARM 17.24.728 (Relevant and Appropriate) sets forth requirements for the composition of vegetation on reclaimed areas.

ARM 17.24.730 and 17.24.731 (Relevant and Appropriate) provide that the revegetated area must furnish palatable forage in comparable quantity and quality during the same grazing period as the reference area. If toxicity to plants or animals is suspected, comparative chemical analyses may be required.

ARM 17.24.733 (Relevant and Appropriate) provides additional requirements and measurement standards for trees, shrubs, half-shrubs, and other woody plants.

ARM 17.24.751 (Relevant and Appropriate) mandates specific measures that must be undertaken or actions that must be refrained from to enhance or prevent harm to fish, wildlife, and related environmental values.

ARM 17.24.761 (Relevant and Appropriate) specifies measures that must be implemented to control fugitive dust emissions during certain mining and reclamation activities. Such measures would be relevant and appropriate requirements to control fugitive dust emissions during excavation, earth moving, and transportation activities conducted as part of the remedy at the site.

3.3.7 Natural Streambed and Land Preservation Act (Applicable)

Section 75-7-102, MCA, and ARM 36.2.410 (Applicable), which place limitations on and specify criteria to be considered in approving projects affecting streambeds, would be applicable (substantive provisions only) if alternative developed alters or affects a streambed.

3.4 OTHER MONTANA LAWS

The following "other laws" are included here to provide a reminder of other legally applicable requirements for actions being conducted at the site. They do not purport to be an exhaustive list of such legal requirements, but are included because they set out related concerns that must be addressed and, in some cases, may require some advance planning. They are not included as ARARs because they are not "environment or facility siting laws" and they are not subject to ARAR waiver provisions.

The administrative/substantive distinction used in identifying ARARs applies only to ARARs and not to other applicable laws. Thus even the administrative requirements (e.g., notice requirements) of these other laws must be complied with in this action. Similarly, fees that are based on something other than issuance of a permit are applicable.

3.4.1 Montana Safety Act (Applicable)

Sections 50-71-201, 202 and 203, MCA, state that every employer must provide and maintain a safe place of employment, provide and require use of safety devices and safeguards, and ensure that operations and processes are reasonably adequate to render the place of employment safe. The employer must also do every other thing reasonably necessary to protect the life and safety of its employees. Employees are prohibited from refusing to use or interfering with the use of safety devices.

3.4.2 Employee and Community Hazardous Chemical Information Act (Applicable)

Sections 50-78-201, 202, and 204, MCA, state that each employer must post notice of employee rights, maintain (at the work place) a list of chemical names of each chemical in the work place, and indicate the work area where the chemical is stored or used. Employees must be informed of the chemical at the work place and trained in the proper handling of the chemicals.

3.4.3 Water Rights (Relevant and Appropriate)

Section 85-2-101, MCA, declares that all waters within the State are the state's property, and may be appropriated for beneficial uses. The wise use of water resources is encouraged for the maximum benefit to the people and with minimum degradation of natural aquatic ecosystems.

Parts 3 and 4 of Title 85, MCA, set out requirements for obtaining water rights and appropriating and utilizing water. All requirements of these parts are laws which must be complied with in any action using or affecting waters of the state. Some of the specific requirements are set forth below.

Section 85-2-301, MCA, of Montana law, provides that a person may only appropriate water for a beneficial use.

Section 85-2-302, MCA, specifies that a person may not appropriate water or commence construction of diversion, impoundment, withdrawal or distribution works therefore except by applying for and receiving a permit from the Montana Department of Natural Resources and Conservation (DNRC). While the permit itself may not be required under federal law, appropriate notification and submission of an application should be performed and a permit should be applied for in order to establish a priority date in the prior appropriation system. A 1991 amendment imposes a fee of $1.00 per acre foot for appropriations of groundwater, effective until July 1, 1993.

Section 85-2-306, MCA, specifies the conditions on which groundwater may be appropriated, and, at a minimum, requires notice of completion and appropriation within 60 days of well completion.

Section 85-2-311, MCA, specifies the criteria which must be met in order to appropriate water and includes requirements that:

1. there are unappropriated waters in the source of supply;

2. the proposed use of water is a beneficial use; and

3. the proposed use will not interfere unreasonably with other planned uses or developments.

Section 85-2-402, MCA, specifies that an appropriator may not change an appropriated right except as provided in this section with the approval of the DNRC.

Section 85-2-412, MCA, provides that, where a person has diverted all of the water of a stream by virtue of prior appropriation and there is a surplus of water, over and above what is actually and necessarily used, such surplus must be returned to the stream.

3.4.4 Groundwater Act

Section 85-2-516, MCA, states that within 60 days after any well is completed a well log report must be filed by the driller with the DNRC and the appropriate county clerk and recorder.

3.4.5 Water Well Contractors, §§ 37-43-101 et seq., MCA

ARM 36.21.402 provides that any person who drills or otherwise constructs water wells must have a State license.

ARM 36.21.403, 36.21.405, 36.21.406 and 36.21.411 provide requirements for obtaining a license, contents of an application and bonding requirements.

3.4.6 Well Construction Standards

ARM 36.21.635 through 36.21.680 set forth water well construction criteria, public water supply wells criteria, well location requirements, and reporting requirements.

ARM 36.21.701 and 36.21.703 specify that monitoring well constructors must be licensed and must verify their experience.

3.4.7 Occupational Health Act of Montana, §§ 50-70-101 et seq., MCA

ARM 17.74.101 provides that no worker shall be exposed to noise levels in excess of the following values (expressed in decibels measure on the A-weighting network (dbA)):

Continuous or Intermittent Noise Exposures

Duration per Day (in hours)	Noise Level (dbA)
8	90
6	92
4	95
3	97
2	100
1-½	102
1	105
¾	107
½	110
¼	115

These values apply to the total time of exposure per working day regardless of whether or not this is one continuous exposure or a number of short-term exposures. If a worker is exposed to noise levels in excess of these values, feasible administrative or engineering controls must be used by the employer to reduce nose levels. If these controls are inadequate, the employer must provide personal hearing protective equipment to achieve the foregoing maximum permissible noise exposure levels. This regulation is applicable only to limited categories of workers and for most workers the similar federal standard in 29 CFR § 1910.95 applies.

ARM § 17.74.102 addresses occupational air contaminants. This rule establishes maximum threshold limit values for air contaminants under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse health effects. In accordance with this rule, no worker shall be exposed to air contaminant levels in excess of the threshold limit values listed in the regulation. This regulation is applicable only to limited categories of workers and for most workers the similar federal standard in 29 CFR § 1910.1000 applies.